SHIP TO SHIP
Transfer Guide

for Petroleum, Chemicals and Liquefied Gases

CDI

INTERNATIONAL CHAMBER OF SHIPPING

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General principles

Section 1

1.1 Introduction

The purpose of this document is to provide guidance to Masters and operators of vessels undertaking side-by-side ship to ship (STS) transfer operations of crude oil, petroleum products, chemicals and liquefied gases, both at sea and in port. Other parties may also benefit from studying these guidelines. Such parties may include ship charterers, traders, STS service providers and those contracting STS service providers.

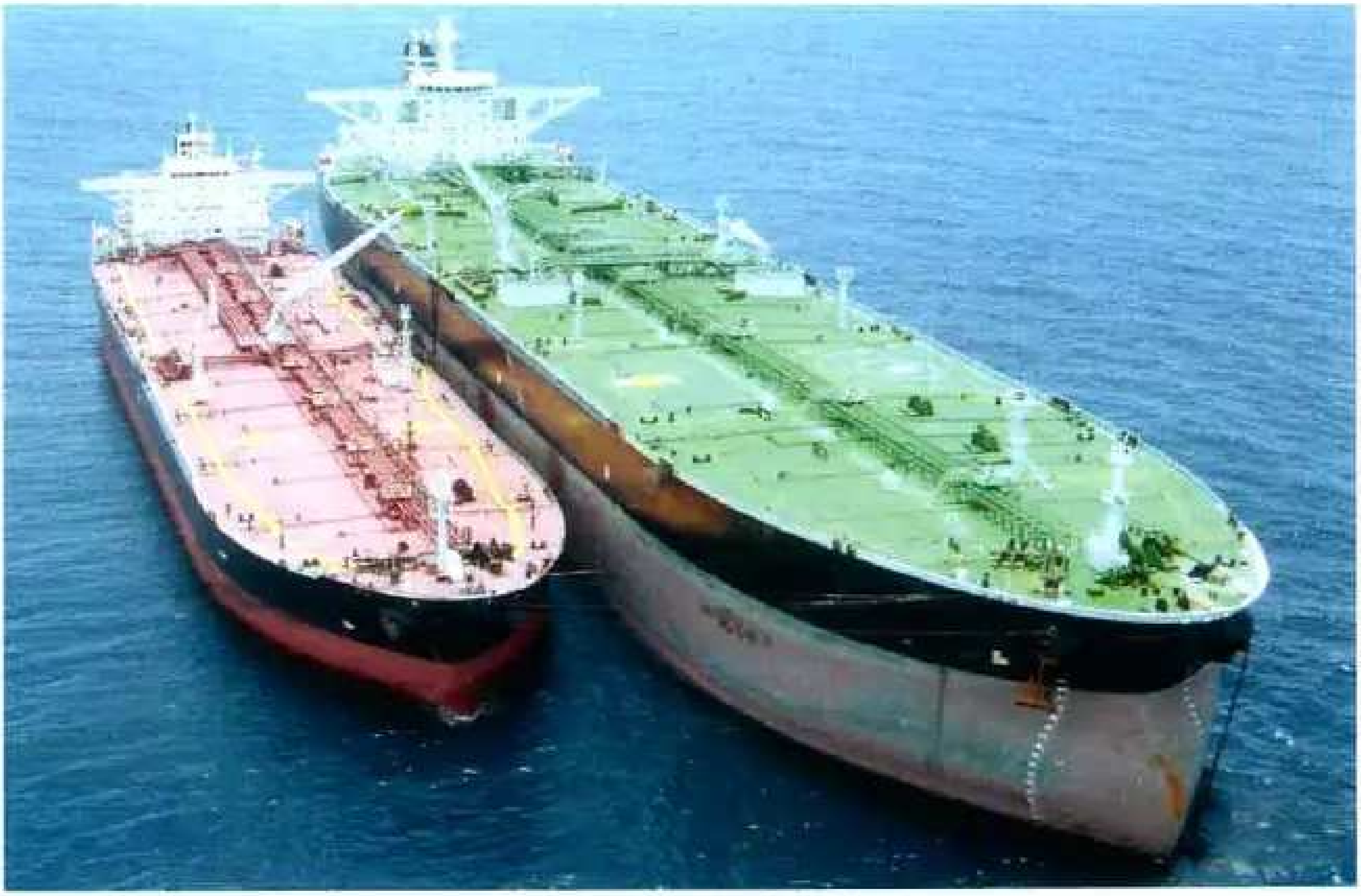

Figure 1.1: Ship to ship transfer at anchor

The structure of this Guide has been developed such that all general references to STS operations that are applicable irrespective of the cargo being transferred are included in the main section of the document. Recommendations that relate to a particular cargo are included in separate appendices for crude oil and petroleum products, chemicals, liquefied petroleum gas (LPG) and liquefied natural gas (LNG).

The advice contained in this Guide may be supplemented by instructions from individual ship operators in order that particular aspects of their own procedures can be covered.

The requirements of *MARPOL* Annex I, chapter 8, *The Prevention of Pollution During Transfer of Oil Cargo Between Oil Tankers at Sea* (reference 35), should be adhered to for all applicable operations involving oil cargoes. The requirement for vessels to be provided with an STS operations plan should be considered for adoption by vessels involved in the STS transfer of other cargoes as recommended best practice. For further guidance on the content of STS operations plans, reference should be made to appendix A.

1.2 Background

The STS transfer of liquid cargoes in port and at sea has become common practice. Experience gained from these regular operations has proved that STS transfers are safe given the use of suitable equipment and compliance with proper procedures, including the establishment of safe environmental operating limits.

Amendments to *MARPOL* entered into force on 1 January 2011 and contain requirements relating to the at sea transfer of Annex I (oil) cargoes between vessels (see appendix A).

1.3 Scope

This document provides guidance for STS transfer operations undertaken both at sea and in port. The term at sea is intended to indicate offshore waters or partially sheltered waters.

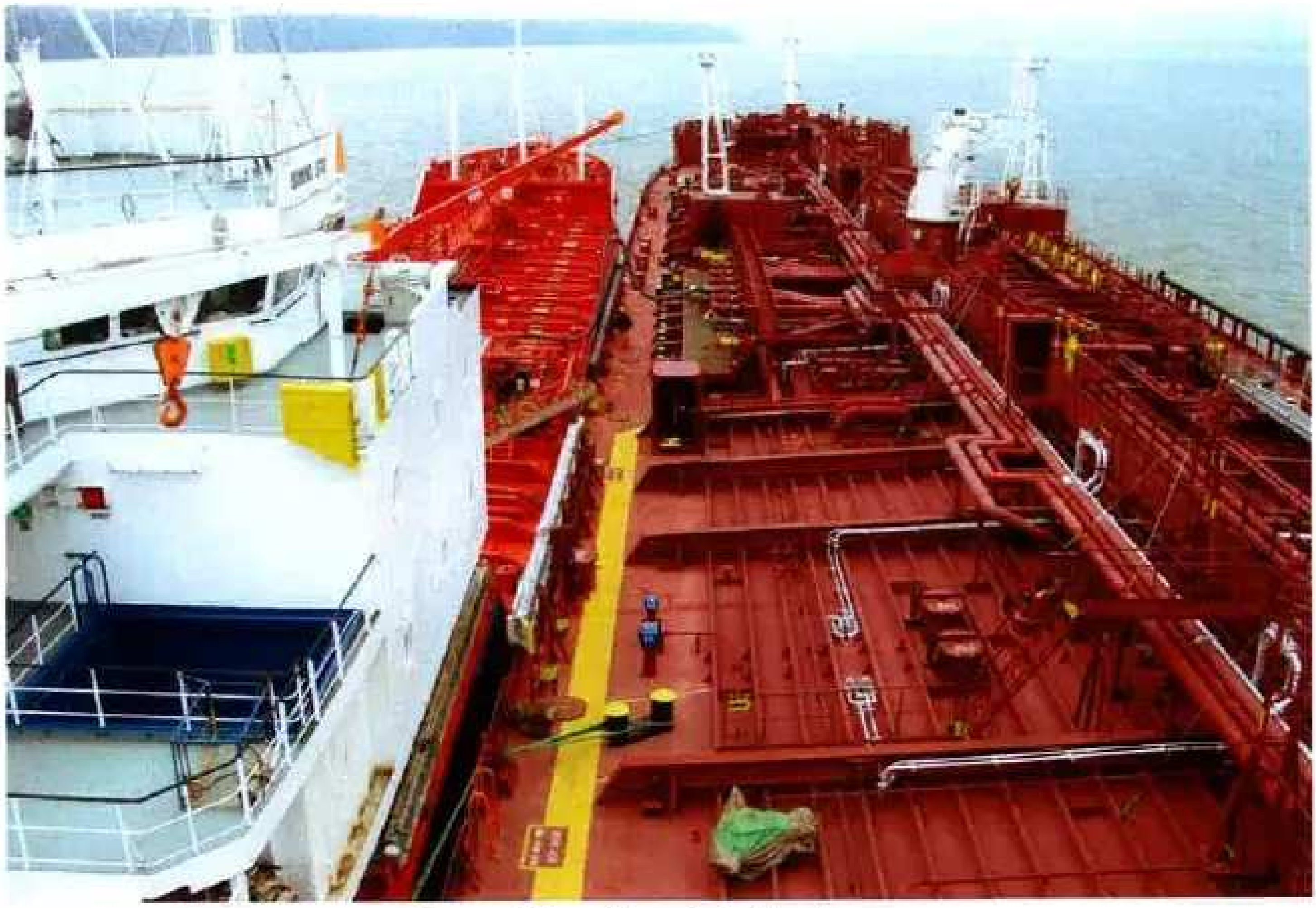

Figure 1.2: Ship to ship transfer in sheltered waters

The scope of this Guide has been significantly expanded to take account of in port transfers (compared with that of earlier publications). These may involve transfers to or from a vessel at anchor, moored to buoys or alongside, and may involve multiple vessels some of which, particularly in the chemical trade, may be of small size and include manned and unmanned barges and estuarial craft.

For clarity, throughout this Guide, the common terminology of Discharging ship, Receiving ship, Mother ship and Daughter vessel has been used to describe the vessels involved in STS operations. Similarly, the terms person in overall advisory control (POAC), STS Superintendent and Mooring Master have been used throughout to describe key roles associated with an STS operation.

This Guide may also provide background advice to companies operating storage, production or floating re-gasification facilities where direct transfer to seagoing ships takes place.

In addition, the Guide may be of assistance when carrying out emergency STS transfer operations. However, it is recognised that, according to the unique circumstances of each emergency situation, it may be necessary to adopt procedures that vary from those detailed in this document.

1.4 Risk assessments

A risk assessment should be undertaken when considering the suitability of an STS transfer location. A further risk assessment should be made for the STS operation.

Guidance on the recommended scope and content of risk assessments is provided in section 3.2. In addition, appendix K includes general guidance to support the risk assessment process.

1.5 Control of operations

1.5.1 General

All STS transfer operations should be conducted under the co-ordination and advisory control of one individual, who will either be one of the Masters concerned, an STS Superintendent or the POAC (depending on the cargo – see below). To prevent fatigue during extended operations, the role may be formally transferred to another suitably qualified person (see section 1.5.2).

If the Masters involved in the STS operation are unfamiliar with, or inexperienced in, STS transfer operations, it is recommended that an STS Superintendent is employed to advise them. There are STS service companies offering such services. Before employing such assistance, those parties contracting STS service companies should take steps to ensure that the STS service provider will provide trained and experienced STS Superintendents and, where required, properly qualified POACs.

For transfers undertaken at sea involving *MARPOL* Annex I cargoes, the designation of a POAC is a mandatory requirement (see appendix A). The POAC will either be one of the Masters concerned or an STS Superintendent.

It is not the intention of these recommendations to suggest that the POAC or STS Superintendent in any way relieves the ship's Master of any of his authority, duties or responsibilities. The Master of each vessel shall always remain in command of his vessel, crew and cargo, and shall under no circumstances permit safety to be jeopardised by the actions of others.

Prior to the commencement of an STS transfer operation, the Masters of each vessel, together with the STS Superintendent or POAC, should discuss each key component of the operation (as applicable: fendering, manoeuvring, mooring, hose connection, cargo transfer, hose disconnection, unmooring and unfendering). The purpose of this discussion is to ensure that key personnel involved in the operation clearly understand and agree how the operation will be conducted and agree the content of the joint plan of operation (JPO) (see section 5.2).

1.5.2 Manning for ship to ship operations and the prevention of fatigue

A proper deck and bridge watch should be established and maintained on each vessel underway or at anchor for the duration of the operation. Where appropriate the principles of bridge team management should be observed. See *Bridge Procedures Guide* (reference 19). When alongside in port, normal safe deck and cargo watchkeeping duties should be maintained by all vessels involved.

It is to be expected that STS transfer operations will place additional demands on ships' crews, as personnel are not only required for the cargo transfer operations and tending of moorings, but may also be needed to keep a safe navigational or anchor watch throughout the operation.

Analysis of accident data and research within the marine industry points to fatigue as a cause or contributing factor to human error because of its impact on performance. Human error from fatigue is also shown to have contributed to a number of marine casualties.

In the planning phase for an STS transfer operation, in cooperation with the Masters of the nominated vessels, due account should be taken of the estimated duration and complexity of the operation and an assessment made of the additional workloads associated with the activity. The aim should be to ensure that all personnel (including STS Superintendents, POACs and Mooring Masters) remain fatigue free and that minimum rest periods, as required by applicable legislation, are complied with, particularly when conducting multiple transfers. If necessary, additional personnel should be placed on board to assist with the STS transfer operations. Consideration may also need to be given to the provision of an additional STS Superintendent where workloads are indicated to be high or operations are likely to be over an extended period.

Excess noise levels in the vicinity of rest areas can compound fatigue problems. The impact of noise should be monitored and, where necessary, corrective measures taken.

1.6 Role of a ship to ship Superintendent

The role of the STS Superintendent is not to relieve the Master(s) of their duties or responsibilities. The STS Superintendent should ensure, through the provision of professional advice and guidance to the Master(s), the co-ordination and safe completion of the STS operation.

It is recommended that the STS Superintendent:

- Reviews the location-specific risk assessment.
- Reviews the JPO and associated risk assessments.
- Verifies that agreed STS operating procedures are followed and that the operation is conducted in compliance with all applicable regulatory requirements.
- Confirms that all required reports are made to the appropriate authorities.
- Confirms that all relevant checklists are completed.
- Oversees the correct placement of primary and secondary fenders.
- Sights and reviews mooring equipment.
- Conducts a pre-operations discussion with the responsible persons of involved vessels, including lightering support vessel and tugs, as appropriate.
- Confirms that personnel involved in each part of the operation are properly briefed and understand their responsibilities.
- Discusses current and forecasted environmental conditions and the need for their continuous monitoring throughout the operation(s).
- For at sea transfers, discusses passage planning and agrees courses and speeds for manoeuvring and mooring operations.
- Verifies joint agreement of the mooring and unmooring plans.
- Reviews and verifies that any site-specific risk mitigations are in place.
- Supervises vessel approach and manoeuvring alongside.
- Confirms the safe connection of transfer hoses/arms and any associated emergency release systems (ERS).
- Verifies that any emergency shutdown system (ESD) is properly connected and tested.
- Confirms that cargo transfer rates are being monitored together with associated vapour management procedures.
- Verifies that the integrity of the mooring arrangement is being continuously monitored.
- Ensures that contingency plans are activated in the event of an emergency.
- Verifies that cargo transfer lines are properly drained and, where required, purged.
- Confirms safe disconnection of hoses/arms.
- Supervises the unmooring and the separation of vessels.
- Where applicable, supervises the return of primary and secondary fenders and transfer equipment.

The STS Superintendent should advise the Master when to suspend or terminate the STS operation.

In fulfilling the above role, in some locations the STS Superintendent may be supported by a Mooring Master Assistant.

1.7 Person in overall advisory control

The role of the POAC is not to relieve the Master(s) of their duties or responsibilities, but to provide professional advice and guidance to the Master(s) in the co-ordination and safe completion of the STS operation.

A designated POAC of the STS operation is required for at sea transfers of *MARPOL* Annex I cargoes, and will be either one of the Masters concerned or an STS Superintendent. The role of the POAC will be the same as that described for an STS Superintendent in section 1.6.

For STS transfers undertaken at sea involving *MARPOL* Annex I cargoes, the IMO has published guidance on the qualifications of the POAC and the following is based on the content of the *IMO Manual on Oil Pollution*, section 1, chapter 6 (reference 12):

For transfers involving *MARPOL* Annex I cargoes, the POAC should have at least the following qualifications or level of experience:

- An appropriate management level deck licence or certificate meeting international certification standards, with the *International Convention on Standards of Training Certification and Watchkeeping for Seafarers (STCW)* (reference 9) and dangerous cargo endorsements up-to-date and appropriate for the ships engaged in the STS operation.
- Attendance at a recognised ship handling course.
- Experience in conducting mooring/unmooring operations in similar circumstances and with similar vessels.
- Experience in oil tanker cargo loading and unloading.
- A thorough knowledge of the transfer area and surrounding areas.
- Knowledge of spill clean-up techniques, including familiarity with the equipment and resources available in contingency plans.
- Knowledge of STS operations plans (see appendix A1.5) and associated joint plans of operation (see section 5.2).

For transfers involving cargoes other than *MARPOL* Annex I cargoes, it is recommended that the STS Superintendent has similar qualifications and levels of experience to those detailed above, relevant to the type of cargo transferred.

1.8 Training and familiarisation of ship's personnel

It is likely that the pre-operation risk assessment (see section 3.2.2) will identify that many of the crew will be required to take on additional or different tasks, roles and responsibilities than they would when conducting a routine port and cargo operation. The risk assessment may also identify emergency scenarios that are not included in the vessel's regular exercise programme.

It is important that any additional roles and responsibilities are identified and that suitable training is provided prior to the operation. The training requirement for each ship will differ depending on the recent experience of the individuals on board. It should be noted that factors such as location, service provider and equipment to be used may result in additional training being required for experienced personnel. Where there is little or no experience with STS operations, consideration should be given to providing additional experienced STS personnel prior to the operation to assist with the training of personnel and the STS operation.

Training may include items such as:

- Roles and responsibilities of involved parties.
- Bridge watchkeeping procedures.
- Deck watchkeeping procedures.
- Machinery operation.
- Mooring and unmooring.
    - Procedure for passing lines between vessels.
    - Quick release systems.
    - Properties of mooring lines.
    - Fender management.
    - Measures to minimise chafing of lines.
    - Awareness of snap-back zones.
- Operation of cranes.
- Personnel transfer.
- Transfer equipment.

- Connection and disconnection of hoses/arms.
- Hose slinging and support arrangements.
- Emergency operations.
    - Aborting mooring operations.
    - Collision.
    - Cargo spill.
    - Emergency disconnection and departure.

The level of knowledge and training required will depend upon a person's role and past experience.

The JPO will be specific to the prevailing circumstances and it is important that the content is discussed with the vessel's staff to ensure they have a good understanding of the operation.

1.9 Security

The requirements of the International Ship and Port Facility Security (ISPS) Code, together with any local requirements, should be adhered to throughout the operation, with each vessel remaining responsible for its own security at all times.

Prior to commencing the STS transfer operation, the following security issues should be discussed and any associated decisions recorded:

- Exchange of sufficient information to determine if a Declaration of Security is required.
- Agreement on how, and between whom, communications regarding security are to be made.
- Actions to be taken in the event of a breach of security, such as suspending operations and separating vessels.

Local regulations may impose exclusion zones around the STS transfer operation. Due consideration should be given to establishing safe distances to be maintained from other vessels and actions to be taken if such distances are compromised.

1.9.1 Security on multiple vessels

The port, the terminal and vessels alongside will each have security plans in compliance with the ISPS Code or respective country codes. The STS Superintendent should be aware of the current security requirements and security level imposed by the port and this information should be conveyed to all vessels coming alongside.

Where the transfer operation is to take place alongside a terminal, the terminal and the gangway security will monitor all personnel movements from the shore. It is therefore important that other vessels coming alongside the ship moored alongside the terminal indicate any visitors they expect. If unreported visitors for any of the involved vessels present themselves at the gangway of the ship moored alongside the terminal, they should not be allowed access until confirmation has been received from the relevant vessel alongside.

The transfer organisers, when planning the STS operation, should complete a security assessment. If there is any concern that security is not properly addressed at the port, a risk analysis should be undertaken of all aspects of the STS transfer for the terminal and vessels alongside. The assessment should:

- Identify security measures and procedures in place.
- Evaluate the assets and infrastructure to protect.
- Identify any threat to the port, the terminal, the discharging ship and vessels alongside.
- Identify areas of operation vulnerable to security threats.
- Consider weaknesses in infrastructure, security policies and procedures.

Conditions and requirements

Section 2

2.1 Ship to ship compatibility

2.1.1 General

When organisers are planning a ship to ship (STS) transfer operation they should ensure that the ships to be used are compatible in design and equipment. A compatibility assessment should be undertaken to confirm the suitability of the vessels for the planned operation and to identify any aspects that may require particular management.

It is recommended that information relating to the overall dimensions, freeboard, position of manifolds, mooring points and fenders is passed to the Masters of the ships at the earliest opportunity. For planned at sea STS operations, the initial information required in checklist 1 of appendix E should be supplied to the organisers and, where appropriate, STS service providers, by the ship operators.

STS compatibility assessments should include, but not be limited to:

- Vessel characteristics as per the STS operations plan (see appendix A) and/or checklist 1 (see appendix E).
- Minimum manoeuvring speeds and corresponding revolutions per minute (RPM).
- Manifold arrangements, sizes and number to be used.
- The number of hose connections available.
- The minimum and maximum expected height of the cargo manifold from the waterline during the transfer operation, and the freeboard differences during the cargo transfer.
- Whether the hose handling cranes or derricks are in a satisfactory condition, are of suitable safe working load (SWL) and have an appropriate outreach.
- That hose supports at the ship's side are adequate to prevent damage to hoses through chafing.
- Cargo handling equipment, types of cargo pumps and any restrictions to be imposed to ensure a safe transfer rate for the products being handled.
- Designed maximum permitted pumping/receiving rates for all vessels involved.
- Mooring arrangements, including the type of mooring lines and the requirements for enclosed fairleads.
- The identification of issues associated with vessels of similar length (see section 2.1.2).
- Arrival and departure displacement, draught, freeboard and parallel body length and associated fendering requirements.
- Hazardous zone diagrams, both horizontal and vertical, and gas safe areas, taking into account the changing cargo deck heights and overlapping flammable zones of the ships involved.
- The potential for toxic vapour release and identification of hazardous zones.
- Information relating to any clear air flow obstructions that may cause eddies to be created, affecting the shape and concentration of any gas plumes from vents. Venting from smaller ships may result in a hazard on the elevated deck or operational area of a larger vessel alongside.
- Wind direction and hazards associated with flue gases and sparks, particularly when ships are moored stem to stern.
- Personnel transfer arrangements, if applicable.
- Emergency shutdown (ESD) and communication systems.
- Contingency planning and emergency procedures.
- Cargo transfer and ballast plans, including anticipated duration.
- Vapour management capacity of each vessel and, where vapour return/balancing is used, the compatibility and capacity of ship systems.
- For liquefied gas transfers, the cargo temperatures, pressures and densities for both vessels.

Consideration should be given to the precautions and mitigation measures regarding bridge wings that are necessary to reduce the risk of contact with the other ship. It is recommended that ships which have bridge wings extending beyond the beam are not used if it is determined that there is risk of contact, especially when the bridge wing of one vessel is lower than the deck edge of the other, or when the bridge wing of one ship may interfere with structures such as lifeboats on the main deck of the other.

In cases where the operation involves similarly sized ships, mitigation measures should be considered in order to prevent bridge wing contact. Mitigating measures may include longitudinally offsetting the manifolds and using larger diameter fenders to increase the stand-off between the two ships.

Appendix L provides an example of a compatibility questionnaire. Although the questionnaire is intended for use when planning an STS transfer between liquefied natural gas (LNG) vessels, much of the information contained may be relevant when planning transfers involving other cargoes.

2.1.2 *Ship to ship transfer operations involving vessels of a similar length*

For the purposes of STS operations, vessels having a length overall (LOA) differential of less than 10% would generally be considered as being of a similar length. The risk assessment should include mitigation measures for the operation, such as those detailed below, in order to reduce the risk to an acceptable level:

- Identification of optimum mooring arrangement. Due to the head lines being in a breast line configuration, it may be necessary to deploy additional lines in a fore and aft direction to compensate.
- Identification of optimum securing arrangements for fenders to ensure that mooring arrangements are not compromised due to a lack of useable chocks/fairleads.
- The adjustment of the fore and aft positions of the ships so that the bridge wings are offset. In doing so, it should be ensured that all the primary fenders will rest on the parallel body of both the vessels throughout the operation and that hose lengths will be sufficient to accommodate the resulting manifold offset.
- For transfer operations conducted at anchor with one of the vessels offset, consideration should be given to the need for extra head lines to counter the additional forces on the vessel with the exposed bow.
- Provision of larger diameter fenders to increase separation distances.
- The reduction of limiting environmental parameters, once the lead and effectiveness of the mooring line configuration have been considered.

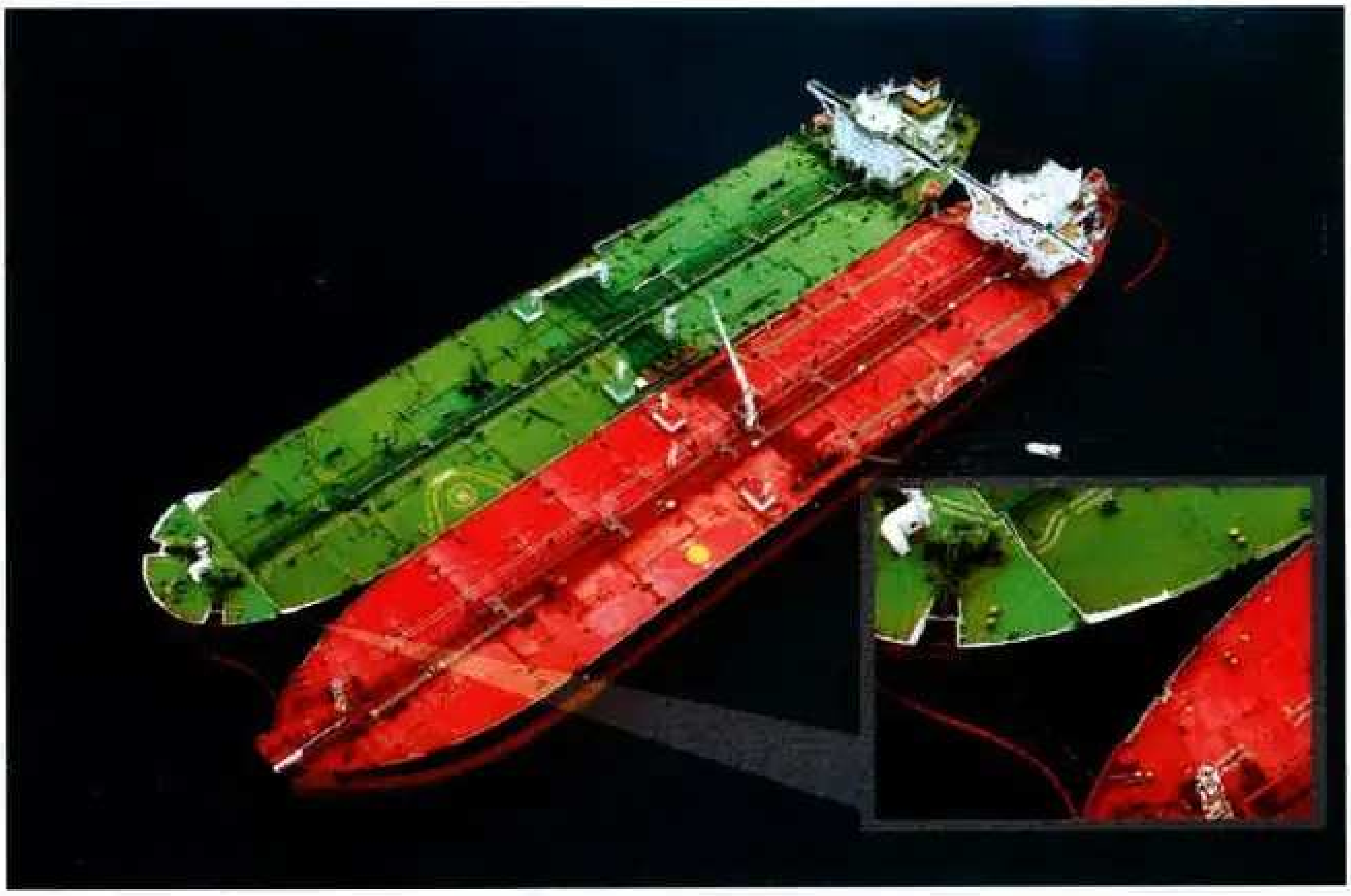

Figure 2.1: Ship to ship transfer operation

2.1.3 *Use of dumb barges*

Dumb barges may be used for STS operations. The barging company is responsible for the barges they operate. While the barge is being towed or pushed the tug Master is the responsible person. For mooring, unmooring and also during transit, the tug crew is responsible for the handling of the barge. When alongside a berth or discharging vessel, the barge comes under the facility's security plan. During cargo operations, an operator either belonging to the tug or appointed by the barge company takes charge of the barge and is responsible for ensuring safe operations.

Barges have their own independent diesel power unit that drives the cargo transfer pump(s).

Most modern barges are fitted with float-type high level gauges with an audible alarm. Alarms are mostly powered by a portable power unit (a battery pack) that is brought on board by the operator. Depending on the products to be carried, some barges are fitted with hermetic coupling sounding pipes for taking closed soundings. Regular soundings are taken by either a fixed stick system or visually through a sight glass.

It should be noted that dumb barges do not have fixed fire-fighting capability, so portable fire extinguishers should be placed on board during cargo operations. The STS Superintendent should always be aware of when barges are alongside the discharging ship and of any other vessels involved in the transfer operations. It should be ensured that adequate fire-fighting capability is available to cover the operations of the dumb barges.

It should also be noted that mooring to barges can present challenges due to:

- The limited number of mooring wires/ropes available.
- The limited number of winches.
- The limited number of chocks (some of which may be not be closed).
- The difficulty in establishing effective mooring leads.

In many regions inland STS transfer operations are undertaken using dumb barges. The equipment and operational practices used by dumb barges may differ significantly from those recommended in this Guide for conventional STS operations. In such cases, it is recommended that this Guide is used to provide an operational benchmark for information that assists in ensuring the safety of such operations.

2.2 Notification to and approval from authorities

2.2.1 *MARPOL Annex I cargoes*

For STS transfers involving *MARPOL* Annex I cargoes within the territorial sea or the Exclusive Economic Zone (EEZ) of a party to the MARPOL Convention, the Master or agent of each tanker involved is required to notify the relevant Coastal State authorities not less than 48-hours in advance of the scheduled operation. The notification should include the information detailed in appendix A2.2.

2.2.2 *Chemical cargoes*

Government authorities may require notifications for STS transfers involving Annex II cargoes. Where these transfers are conducted within port limits the harbour authority may require notification. In either case a lightering plan may be required. If alongside a terminal, the operator, or owner may also require a copy of the lightering plan. Appendix B2.2 contains further guidance on notification procedures.

2.2.3 *Other cargoes*

For STS transfer involving other cargoes, the organiser should check local and national regulations to determine the level of approval required to conduct the transfer operation. This may require the organiser and appropriate authority to agree the transfer area to be used and to take into account other requirements. At this time, matters pertaining to contingency plans should also be addressed (see section 10.1).

When an STS transfer operation is about to begin in territorial waters, the organiser should assess whether there are any requirements to notify authorities and/or government agencies. If required, notifications may be made either directly by the organiser or, once requirements are known, by formally delegating the task to the STS Superintendent.

2.3 Transfer area

Transfer areas may be defined in legislation by authorities. The size of transfer areas used varies considerably and the space available will impact upon the type of manoeuvre that can be used for the STS operation. Where it is intended that both ships are to be underway, a relatively large transfer area will be needed to accommodate the necessary manoeuvres. Conversely, a ship approaching another ship at anchor or alongside will require a much smaller overall area.

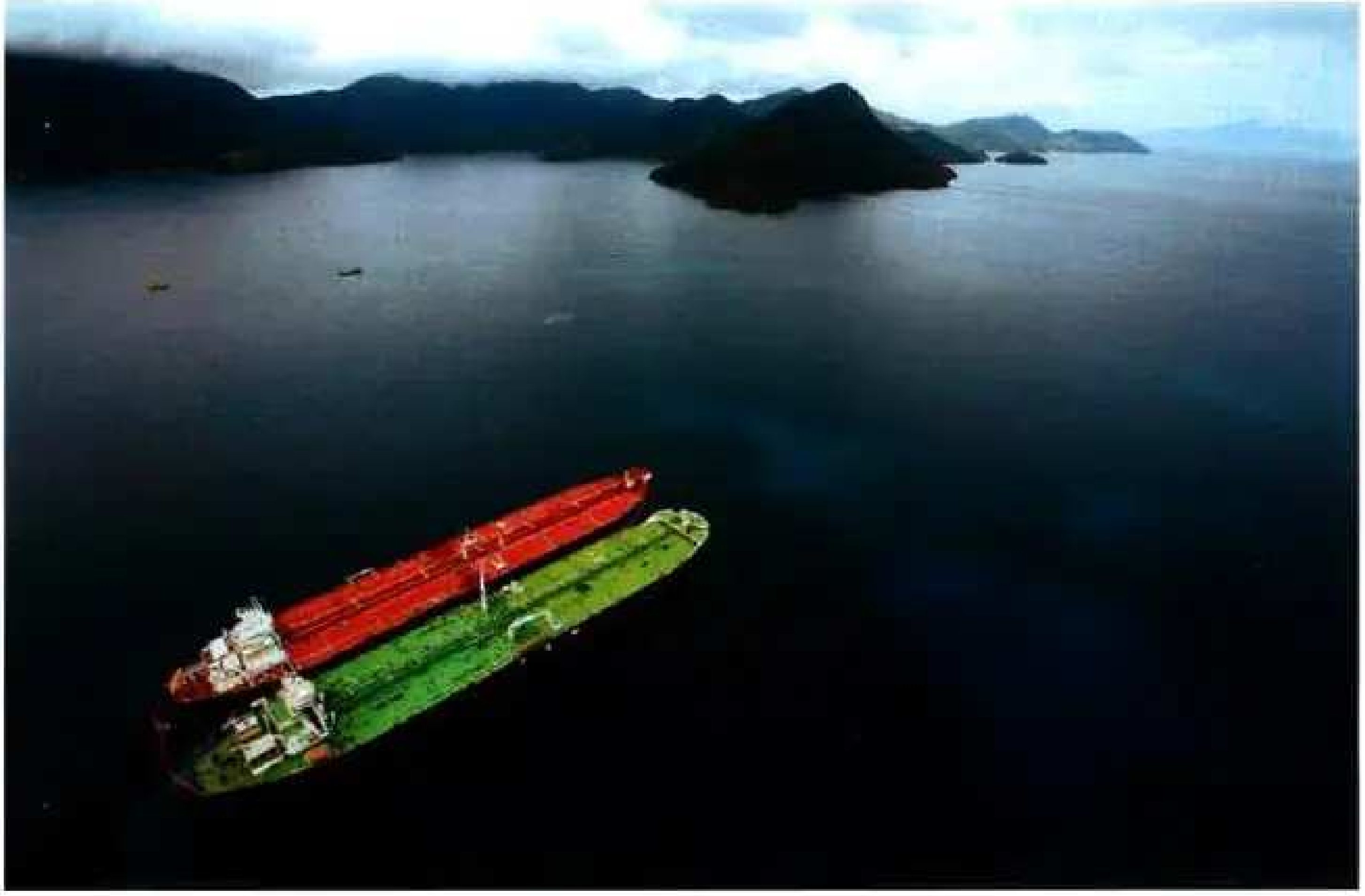

Figure 2.2: Ship to ship transfer operation at anchor in sheltered waters

For all STS transfers, a safe area around the vessels should be agreed and monitored. Contingencies should be developed to address any potential breaches of the safe area. Some harbour authorities may require a safety patrol vessel to be on station throughout the transfer operations.

Within port limits or in specified approved offshore locations, support in the form of pilots and tugs may be available or be required by local legislation.

When assessing the suitability of an STS transfer location, reference may be made to the guidance and example checklists contained within *Ship to Ship Service Provider Management* (reference 16).

When the transfer is to take place alongside a terminal, restrictions on the transfer area should take into consideration the proximity of passing ships and traffic density in the vicinity. Local regulations may not permit more than one vessel alongside at any time and may require terminal facilities to be specifically licensed for STS operations involving double banking.

2.4 Environmental conditions

Weather conditions may impose restrictions on the operation. Some jurisdictions may have regulations regarding limiting weather conditions. Restrictions should be considered for each specific transfer location by the vessels involved.

Information that will determine operational management action should include, but not be limited to:

- Visibility.
- Wind speed and direction.
- Wave and swell height, period and direction.
- Weather forecasts.

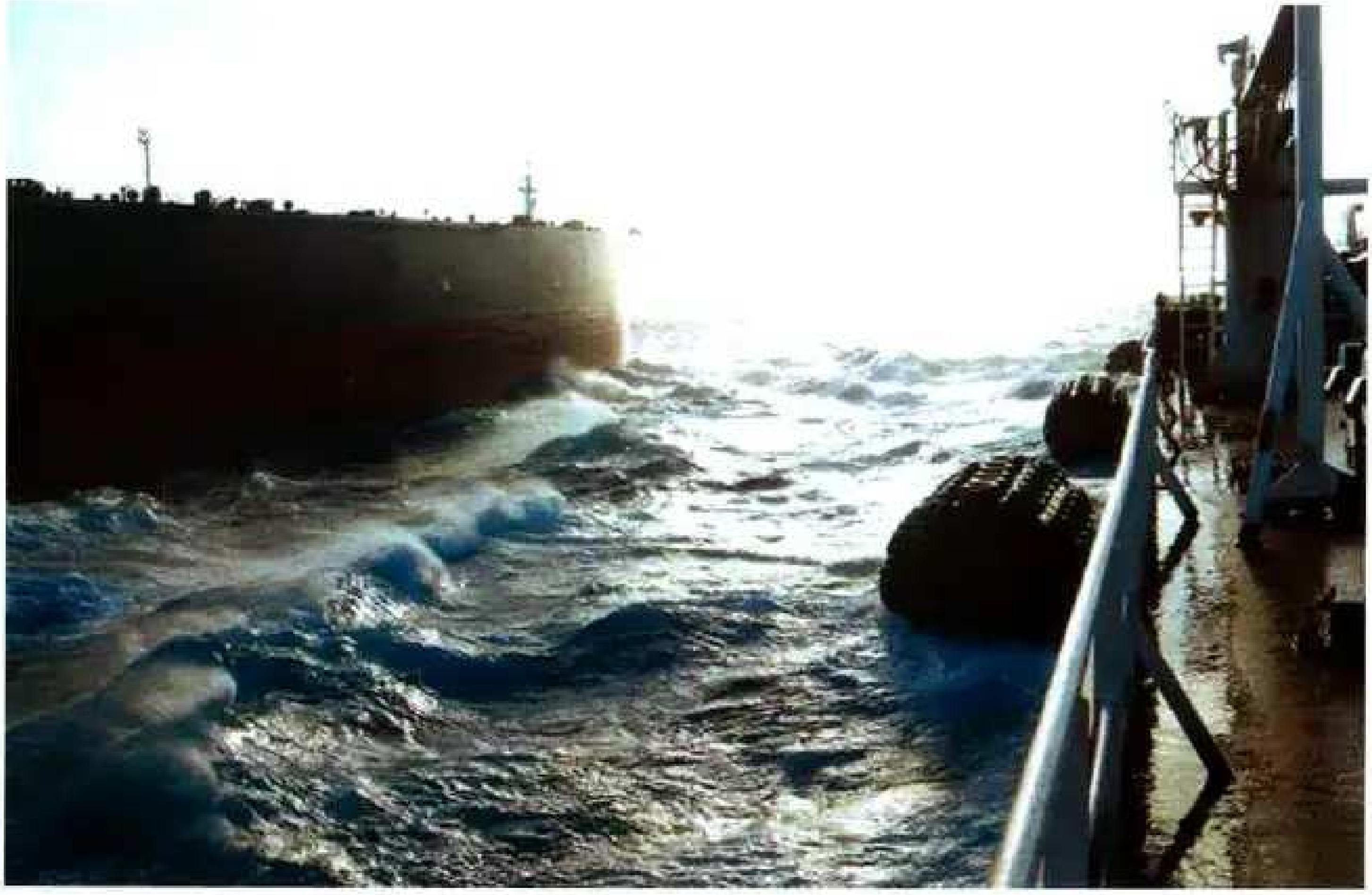

Figure 2.3: Final approach of vessels underway

To ensure that the latest relevant forecast information is available for transfers undertaken at sea, it is recommended that service providers and ship operators utilise specialised weather forecasting services, where available, to provide detailed information on the present and forecast conditions for the STS area. This information should include details of the wind, wave and swell analysis of the location. The information should be distributed to interested parties involved in the operation as it may have operational and commercial implications.

It is impractical to lay down limiting weather conditions under which STS transfer operations can be carried out. Much will depend on the effect of the sea and swell on the fenders or mooring lines and the rolling movements induced in the participating ships, taking into account their relative freeboard and displacement. Factors for at sea operations also include the physical sizes of the ships and their manoeuvring capabilities, the speed of the approaching weather, free surface effect, sloshing limitations, manning and workboat capabilities.

Experience indicates that STS operations in locations subject to long period waves should be treated with caution. It should be expected that mooring loads will increase with wave period or as the period of wave encounter increases.

If cargo transfer is to take place at anchor the combined effect of current and weather conditions on the yawing movements of the anchored ship and the ultimate tension on the anchor cable should be considered.

Throughout any berthing operation the visibility should be sufficient to permit safe manoeuvring, taking into account safe navigation and collision avoidance requirements. Manoeuvres should only start when the relevant personnel are satisfied that conditions are suitable for mooring and cargo transfer.

The Master of any ship involved in the operation retains the right to suspend operations and unmoor should he have concerns regarding the safety of remaining alongside in the prevailing weather and sea state conditions.

For operations undertaken in port, it should be recognised that weather factors can influence available depth of water and tidal heights and can also affect currents in rivers and estuaries and sea states in exposed waters. Permitted underkeel clearances should be constantly monitored and due account taken of any temporary draught restrictions that may be set by the local authority for the given conditions.

2.4.1 *Cold weather precautions*

When conducting STS operations in extreme cold weather conditions, consideration should be given to ensuring the safety of personnel and the ready availability of essential ship systems. Reference should be made to any applicable national or international requirements or recommendations such as those contained in IMO and industry publications. Reference may also be made to *The Use of Large Tankers in Seasonal First Year Ice and Severe Sub-Zero Conditions* (reference 21).

Particular attention may need to be given to the following:

- Provision of appropriate cold weather clothing.
- The potential for slips and falls on icy surfaces.
- The suitability of fenders and cargo transfer equipment.
- The readiness of safety and fire-fighting systems.
- The effective operation of water curtains.
- The proper functioning of pneumatic, steam and hydraulic systems.
- The correct operation of quick release couplings (QRCs).
- The proper operability of high velocity vents, purge pipes, pressure /vacuum (P/V) breakers, ballast tank vents and cargo/ballast system valves.
- As appropriate, ensuring that safety showers and eye wash facilities remain in an operational condition.

Emergency plans, including spill response plans, may need to be revised to take into account the extreme cold weather conditions and/or the presence of ice.

Cargo vapours may be heavier than air in lower temperatures. This can create a low lying flammable or hazardous zone that can spread over the side of the hull onto a lower vessel alongside.

2.4.2 *Ship to ship operations in ice conditions*

STS transfers may take place in areas of sea ice, where ice conditions may vary from open sea to solid pack ice. Before undertaking STS transfers in areas that may be impacted by ice a number of factors should be considered, including:

- The experience that ship's personnel and service providers have of operating in ice.
- The shelter that operating in ice areas offers. Swell, and particularly sea conditions, may be reduced or eliminated within the ice edge.
- Accessibility to the designated STS position for the vessels involved.
- The suitability and ice classification of the ships' hulls to allow operations in ice conditions.
- The need for ice breaking support.
- Fendering considerations will depend on the conditions, but the possibility of the ice itself acting as a fendering agent between the ships should be considered.
- The possibility of structural damage caused by ships compressing the ice between the hulls or from a higher ice classed vessel causing damage to a lower ice classed vessel's hull.
- Contingency plans should address the requirement for safely breaking away in the event of an emergency.
- The oil spill contingency plans should allow for the possibility of product being contained either on the ice or within the open water surrounded by broken ice. Spill response equipment should be capable of operating in the temperatures to be encountered.
- If engines are to be run to keep the propellers and rudders clear of ice, it will need agreement between the vessels.

If it is considered that the actual or potential ice build-up during the operation could have an adverse impact on the safety and the security of the fender moorings or vessel mooring arrangements, the STS operation should be aborted.

2.4.3 Cargo sloshing considerations

The rolling and pitching of vessels involved in STS operations will result in sloshing of cargo in tanks that are slack. Consideration should be given to:

- Ensuring that risks of damage to cargo tank structures and fittings are minimised by strict adherence to safe operational and environmental limits.
- The possible development of electrostatically charged mists when a static accumulator cargo or a cargo/water mixture is in the tanks.
- The correct operation of P/V valves and the possible lifting of the valves, as the movement of the liquid will create pressure fluctuation in the vapour space of the cargo tanks.
- The premature activation of high level alarms and any linked shutdown facilities.
- Optimising each vessel's loading/discharge plans to minimise exposure to free surfaces, especially for STS operations at sea.

Consideration may need to be given to suspending operations in order to consolidate cargo to minimise the impact of sloshing loads.

2.5 Quality assurance of ship to ship service providers

If an STS service provider is employed, the quality of the services and equipment provided are paramount if operations are to be carried out safely, reliably and efficiently. There are currently no international standards for STS service providers. While some form of International Organization for Standardisation (ISO) accreditation, if available, will provide an assurance that an STS service provider has the necessary resources, afloat and ashore, to provide a quality service, this should not be the only determinant of quality. Performance records and previous industry experience may be important when assessing an STS service provider's ability to meet customer and regulatory requirements.

STS service providers should be aware that they may be subject to assessment by users of their services.

Self-assessment can be used by service providers to verify that their safety management systems (SMS) are comprehensive and sufficiently robust to minimise all potential safety and environmental risks in the execution of their operations and to measure and continuously improve their management systems. Guidance on this process is contained in *Ship to Ship Service Provider Management* (reference 16).

Safety

Section 3

3.1 General

For all ship to ship (STS) transfer operations each, Master remains at all times responsible for the safety of his own ship (its crew, cargo and equipment) and should not permit safety to be compromised by the actions of others. Each Master should ensure that the procedures recommended by this guide are followed and, in addition, that internationally accepted safety standards are maintained. In this regard, procedures and practices contained in relevant accepted industry guidance should be adhered to including, as appropriate:

- *International Safety Guide for Oil Tankers and Terminals (ISGOTT)* (reference 1).
- *Tanker Safety Guide (Chemicals)* (reference 2).
- *Tanker Safety Guide (Liquefied Gas)* (reference 3).
- *Liquefied Gas Handling Principles* (reference 4).
- *International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT)* (reference 5).
- *Mooring Equipment Guidelines* (reference 6).

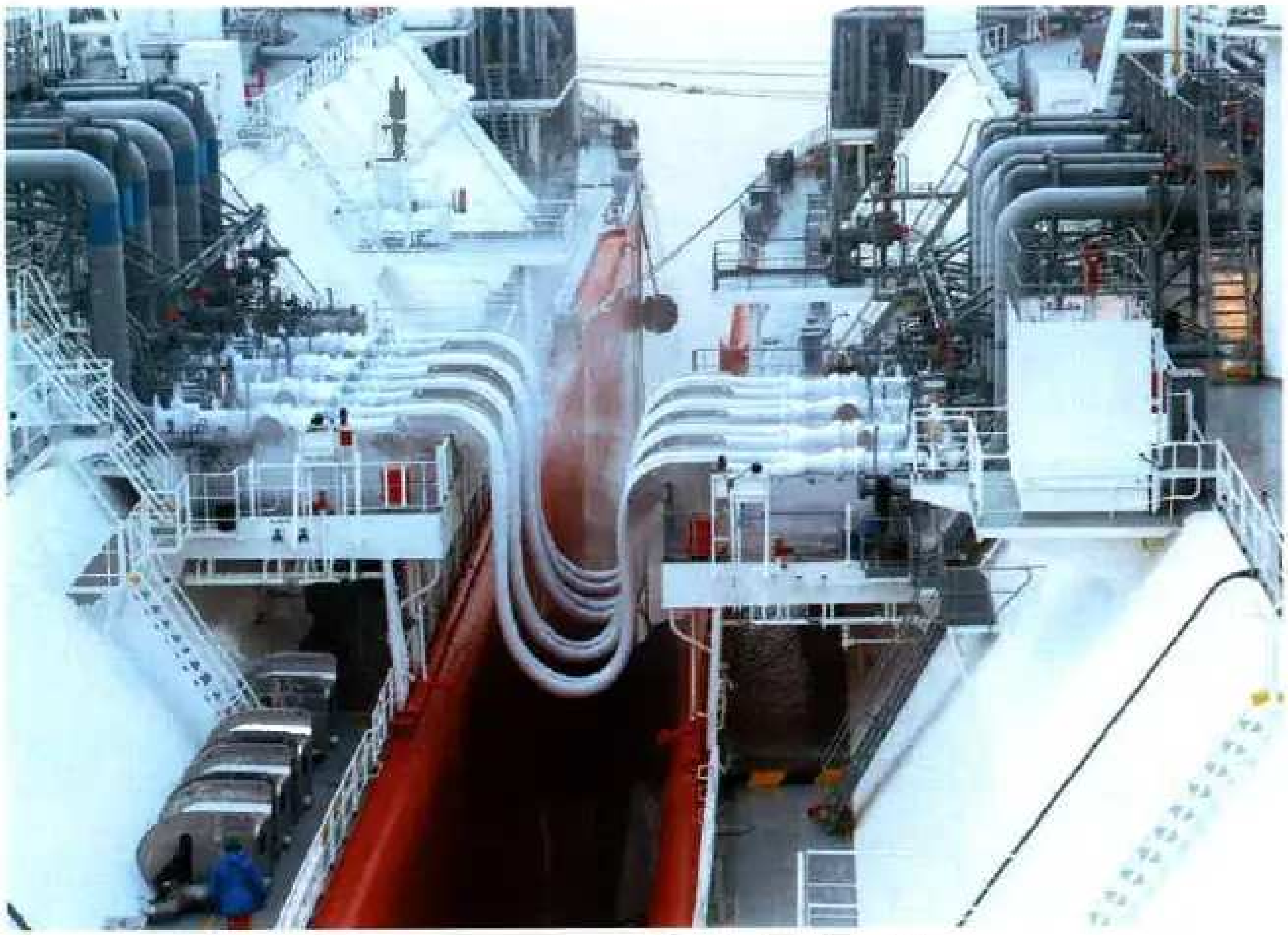

Figure 3.1: Ship to ship transfer of liquefied natural gas (LNG)

3.2 Risk assessment

3.2.1 Risk assessment of transfer location

STS transfers undertaken at sea may pose specific issues that need to be addressed as they often take place in locations that may be beyond the assistance of normal port services.

A risk assessment should be undertaken for each proposed STS location. The outcome of the risk assessment should be factored into the development of operational procedures specific to the location, including implementation of appropriate safeguards to ensure that identified risks are effectively managed.

The risk assessment should be documented and should consider impact and likelihood relating to identified hazards that apply specifically to the location. It should also include an assessment of residual risks following the application of appropriate safeguards, controls or mitigation measures.

Factors considered in the risk assessment should include the following:

- Local legislative requirements.
- Exposure of location to, and/or shelter from, prevailing environmental conditions including, where appropriate, metocean analysis.
- Whether berthing and un-berthing operations are conducted while vessels are underway, at anchor or alongside.
- Whether transhipment operations are conducted while both vessels are underway, at anchor or alongside.
- Traffic density in the vicinity of the location, including the presence of other STS activities.
- Spill and dispersion trajectories and potential environmental impacts.
- Requirement for and availability of any additional spill response resources at the location.
- Availability and capability of support craft at the location.
- Operational and resource integrity of any support elements provided by local subcontractors on site.
- Exposure of location to security threats.
- Operational environmental limits, including abort criteria.
- Navigational hazards in the vicinity of the location.

To ensure that the risk assessment remains fit for purpose, it should be reviewed periodically. When any key condition relating to identified hazards changes, or a new hazard is identified, the risk assessment should be formally revised.

When considering the suitability of a proposed new transfer location, consideration may be given to conducting a mooring analysis to identify environmental operating parameters.

3.2.2 Risk assessment of ship to ship operation

A risk assessment should be undertaken before committing to an STS transfer operation. It should include sufficient information to ensure a good understanding and effective control of the operation. The risk assessment should cover both the physical and operational hazards and the means by which they are managed, and should also address the suitability of equipment.

Risk assessments are an important part of the pre-STS planning process and, as a minimum, should consider the following:

- Ship compatibility, including mooring arrangements (see section 2.1).
- Suitability of the location for the particular operation (see section 3.2.1).
- Properties of the cargo to be transferred.
- Training, experience and qualifications of personnel (see section 1.8).
- Suitable preparation of ships for the proposed operations and sufficient control during operations (see section 5).
- Adequacy of navigational processes (see sections 5 and 6).
- Adequate number of personnel assigned to control and perform the transfer operation (see section 1.5.2).
- Adequacy of communications between ships and/or responsible persons (see section 4).
- Implications of differences in freeboard or the listing of ships when transferring cargo (see section 7.4).
- Equipment, including fenders and transfer hoses (see section 9).
- Anticipated environmental conditions (see section 2.4).
- Emergency planning and procedures (see section 10).

The level of complexity will depend on the type of operation. For a particular transfer area utilising standard approved STS equipment for ships that are fully operational, a generic risk assessment might be appropriate.

If a generic risk assessment is used, it is important that hazards particular to the planned operation are identified and properly addressed. When the risk assessment is incorporated into a standard procedure, additional assessments should be carried out for any deviation from the assumed or standard conditions.

In the light of the complexity of liquefied petroleum gas (LPG) and liquefied natural gas (LNG) STS transfer operations, it is important that the unique elements of each transfer are recognised and that a full and thorough risk assessment is performed as part of the planning of each transfer.

The risk assessment should identify all potential sources and consequences of risk for the operation.

The risks identified will vary according to the type of STS operation under review, for example, the risks associated with being double banked to a vessel moored alongside will differ from the risks associated to side-by-side at anchor or side-by-side with both ships underway.

The risk assessment should take into account the risk reduction measures already in place, their effectiveness and other factors that could change the probability/frequency of a risk event or its impact. Where administrative or procedural controls alone form the basis for risk reduction plans, these procedures should be thoroughly evaluated.

On completion of the exercise, significant risks should have been identified and an appropriate risk management strategy developed to ensure that all identified risks are reduced to an acceptable level, with additional mitigation measures included as necessary.

Consideration may be given to the practicality and benefits of reducing the contents of bunker tanks to a level below the water line on the side where the other vessel is coming alongside.

Further guidance on risk assessment processes is given in appendix K.

3.3 Personal protective equipment and life saving appliances

The appropriate personal protective equipment (PPE) for the products being handled should be worn by crew members engaged in operational tasks on discharging and receiving vessels. Self-contained breathing apparatus (SCBA) sets should be maintained ready for use in their designated locations. When handling certain hazardous products, appropriate PPE may have to be placed at operational locations, particularly around the manifold area. Transfer should not commence until it is ensured that all parties on both vessels are wearing appropriate PPE and, where required, have the appropriate neutralisers/antidotes readily available.

When undertaking multiple transfers simultaneously, either involving several vessels and/or different products, the STS Superintendent is responsible for ensuring that all vessels are aware of the nature of the products being transferred to other vessels and the actions to be taken in the event of an emergency.

All involved vessels should give due consideration to emergency evacuation arrangements, particularly where the launching of lifeboats and life rafts may be impeded by vessels alongside. Mooring plans should consider the need to launch free-fall lifeboats and, if launching arrangements are compromised, alternative means of emergency evacuation should be identified.

The STS Superintendent should be aware of any additional PPE and life saving appliances (LSA) requirements that may be imposed by local harbour regulations or by the terminal and these should be conveyed to the Masters of all vessels.

3.4 Use of checklists

Checklists are an important risk management tool aimed at ensuring that operations are conducted in a safe manner. They are essential reminders of the principal safety factors to be considered, but they should be supplemented by continuous vigilance throughout the whole operation.

Checklist 1 should be used when organisers are planning an operation. Checklists 2 to 5 apply to STS transfer operations undertaken at sea and checklists 6 and 6a are provided as examples that may be used for STS operations in port. All of these checklists are included in appendix E.

Before mooring operations commence, each ship should confirm with the other that all items on checklists 2 and 3 have been checked and found to be correct. Checklist 4 should be completed before commencing the cargo transfer. Checklist 5 should be completed before commencing unmooring and separation.

It should be noted that the checklists have been developed to specifically address factors that are relevant to the STS operation and the questions are supplementary to those contained in standard pre-transfer checklists, such as the *International Safety Guide for Oil Tankers and Terminals (ISGOTT)* Ship/Shore Safety Checklist (reference 1). It is, therefore, important that the *ISGOTT* checklist, or equivalent, is completed prior to the commencement of cargo transfer.

3.5 Material safety data sheets

Both vessels should have copies of the material safety data sheets (MSDS) for the products being transferred.

Where cargo vapours and residues are present in the receiving vessel's tanks, a copy of the MSDS of the previous cargo should be provided to the discharging vessel. This will enable the discharging ship's personnel to take suitable precautions in the event that the previous cargo contained toxic vapours that could be displaced onto the deck of the discharging ship or returned to the ship's tanks through vapour balancing/ vapour return. Particular attention should be given to the potential of H_2S and other toxic substances in the cargo vapours and all necessary personal safety precautions should be taken.

It is important that the MSDS is the one issued by the shipper of the product. Generic MSDS should not be used and transfer operations should not commence before it is verified that the MSDS is for the specific cargo, as issued by the shipper.

3.6 Gas accumulation on open decks

An STS transfer operation should be suspended if cargo vapour accumulates around the decks or manifolds of either ship and should not be resumed until the vapour has dissipated and it is considered safe to do so.

While it is normally anticipated that cargo vapours will be dissipated by environmental airflows across open decks, airflows around vessels engaged in STS transfers are prone to eddies that prevent normal dissipation. Surrounding structures, such as deck frames and deck houses, can impede air flows, creating hazardous spaces where cargo vapours can accumulate. Risk assessments should be conducted to determine control measures when working in these areas.

3.7 Action in case of infringement of safety

If either ship fails to observe any of the safety requirements during the STS transfer operation, this should be brought to the attention of the Master of the ship concerned and the STS Superintendent. Operations should be suspended until the situation is rectified.

3.8 Action in case of cargo leakage

Cargo transfer should be stopped in the event of a cargo leak on either vessel and should not be resumed until the source of the leak is identified, repaired and/or the cause is isolated. Where appropriate, vessel operators and/or local authorities should be notified.

Cargo operations should only resume, with the agreement of both Masters, once the spilled product has been cleaned up or contained, any vapour associated with the leak has dispersed and safe atmospheric conditions have been verified. Due account should be given to any hazardous properties of the cargo or vapour released and the potential dangers to responding personnel.

For transfers involving LNG and, where appropriate, LPG, adequate protection of the vessels' steel structures against brittle fracture should be provided in areas likely to be affected by cargo spillage.

3.9 Helicopter operations

Helicopter operations should not be carried out during any of the following:

- Fender handling.
- Manoeuvring.
- Mooring operations.
- Cargo transfer.

Helicopter operations should be coordinated well in advance between the ships, organisers, agents and the helicopter operator.

All helicopter operations should be carried out in compliance with the *Guide to Helicopter/Ship Operations* (reference 20).

3.10 Safety during cargo transfer

The basic safety requirements for a transfer operation are similar to those for a normal port cargo operation, as contained in the latest edition of accepted industry guides and codes of practice (see section 3.1).

In the event that one of the vessels involved in the STS operation is carrying out simultaneous operations, for example transfer to shore or tank cleaning, the other vessel should be informed and advised of the properties of the products involved and actions to be taken in the event of an emergency.

Particular attention may need to be paid to the fact that personnel on the other vessel might not have experience in dealing with emergencies involving the product(s) being simultaneously handled.

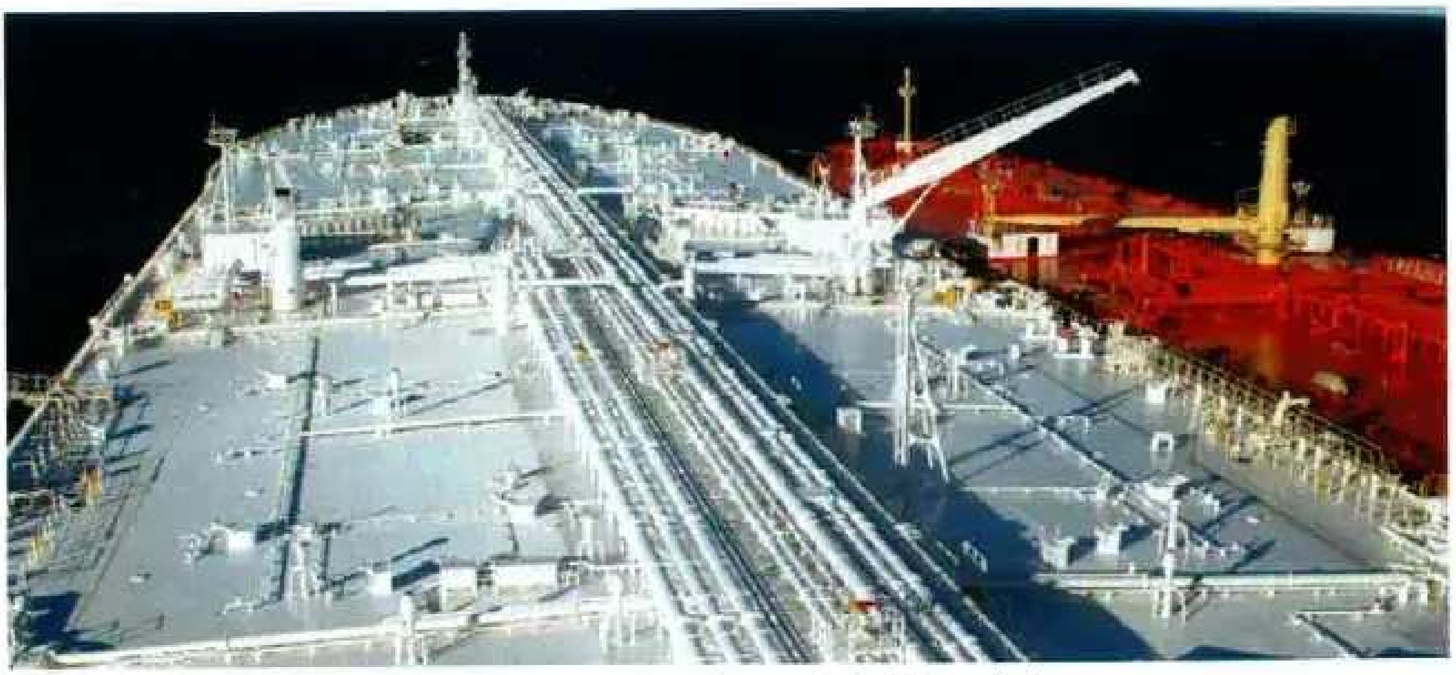

Figure 3.2: Ship to ship transfer operation involving crude oil

3.10.1 *Smoking and naked lights*

Regulations regarding smoking and the use of naked lights should be strictly enforced. Warning notices should be displayed and smoking rooms should be designated and clearly marked.

Due consideration should be given to the different sizes and configurations of vessels, particularly with regard to risks associated with the accommodation spaces of one vessel infringing on the flammable zone of another vessel.

3.10.2 *Earths on electrical switchboards*

Earth indicators showing on the main switchboard indicate a faulty circuit and such faults should be immediately traced and isolated. This is to avoid the risk of arcing, especially in deck areas where hazardous accumulations of gas may be present.

3.10.3 *Machinery operations*

Issues that should be considered with regard to the management of main engines and machinery systems include:

- Sufficient reserve power should be available on the switchboard to overcome sudden loss of generating equipment or increased demand. Standby generators and the emergency generator should be tested and confirmed to be ready prior to STS operations.
- The main propulsion unit should either be in standby mode or on short notice of readiness. This ensures that lubrication, fuel, jacket water and other services to the propulsion unit will be maintained. The state of readiness of the main propulsion machinery of both vessels should be agreed between the Masters and the STS Superintendent.
- Steering gear system operational tests should be carried out prior to commencing the STS operation.
- Any changeover of fuel, for example to low sulphur fuel oil, should be undertaken in good time prior to the start of STS operations. Any automated changeover systems should be stabilised before operations commence.
- On vessels fitted with controllable pitch propellers the main propulsion unit could be operating on low load at zero pitch for prolonged periods. Manufacturer's recommendations should be followed when preparing the plant for such operation.
- On ships fitted with boilers, operations such as soot blowing should be carried out prior to commencing the approach manoeuvre. Incinerators should not be used during transfer operations.
- Exhaust uptakes should be regularly monitored. In the event of sparks being observed, transfer operations should be stopped immediately.

3.10.4 *Electrical isolation*

It is necessary to ensure that electrical isolation is maintained between the ships involved in STS operations during transfer line connection/disconnection and cargo transfer operations. This is to reduce the risk of high energy sparks being produced due to the electrical potential difference between the hulls.

To eliminate the potential for incendive arcing between the two ships, when presenting the hose string for connection one of the following arrangements should be used:

- A single insulating flange fitted at the manifold of one ship or within each hose string and all hoses in the string electrically continuous; or
- A single length of electrically discontinuous hose fitted in each hose string; or
- Hoses that are specially constructed to prevent static build-up and limit electrical conductance to an inherently safe level (see section 9.2.1).

For further information on the electrical properties of hoses and insulating flanges, reference should be made to the guidance contained in *ISGOTT* (reference 1).

Where an insulating flange is used, it is important that no part of the conducting hose outboard of the insulated flange comes into contact with the ship to which the insulating flange is fitted, for example from the use of non-insulated hose saddles, as this could cause a spark.

Where the transfer arrangement includes the fitting of an emergency release coupling (ERC) to one ship's manifold and the hose string is electrically continuous, the insulating flange should be installed on the end of the cargo transfer hose that is not connected to the ERC.

As the potential difference between the ships is managed by ensuring that effective electrical isolation is maintained throughout the transfer operation, cathodic protection systems should remain in operation. However, some local regulations may require their isolation.

Attention should be paid to the possibility of radio frequency induction when cranes are used, particularly when handling electrically continuous hoses. The supporting steel deck, crane structure, lifting wires, shackles, and hose can form an open-ended induction loop and may lead to arcing between the hose end and the steel deck or other part of the ship's structure. Main MF/HF radio transmitters should be switched off and the antennae earthed during hose handling and cargo transfer operations.

3.10.4.1 *Other places where electrical arcing may occur*

All STS mooring lines should be insulated either by using the natural properties of soft mooring lines or by attaching a soft rope tail to the eye of each steel wire mooring line. If using soft rope tails, they should be long enough to extend to the outboard side of the ship receiving the mooring.

Care should be taken to avoid low resistance ship to ship electrical contact such as that possible through the use of non-insulated metal ladders or contact with derrick or crane wire runners and hooks. Fender cages should be properly maintained to avoid any risk of metal to metal contact.

3.10.5 *The use of radio and satellite communication equipment*

3.10.5.1 *General*

When sited outside the gas dangerous zone, radio transmitting equipment is not required to be intrinsically safe.

The risk assessment should consider that when alongside another vessel such equipment may be within the gas dangerous zone of the other vessel or may be exposed to hazardous vapours during operations or in the event of an emergency. While the transmitting power may not be sufficient to create a source of ignition, ancillary equipment such as motors for azimuth control may present a hazard.

3.10.5.2 *Automatic identification systems*

Unless prohibited by local, national or flag State regulations, it is recommended that the Automatic Identification System (AIS) equipment remains in use at all times, including during STS operations.

The very high frequency (VHF) equipment used for the AIS broadcasts need not be set to low power output during STS operations. However, during STS operations consideration should be given to including a phrase to indicate that the ship is anchored or restricted in her ability to manoeuvre.

AIS broadcasts should be considered as supplementary to the obligation to broadcast navigational warnings by other means, not as a replacement.

3.10.6 *Radar use*

The use of radar involves the operation of electrical equipment, such as scanner motors, not suited for operation in a potentially hazardous area. The external electrical equipment of the radar on smaller vessels could infringe the flammable zones of the larger ship. With due consideration for the navigational needs, radars of smaller vessels should be switched off prior to berthing and while alongside.

Consultation between Masters is advisable before radar is used during cargo transfer operations.

3.10.7 *Readiness of fire-fighting equipment*

Fire-fighting equipment should be maintained on station ready for immediate use on all vessels involved in STS operations. Additional portable fire extinguishers, suitable for the product being transferred, should be placed in the manifold area. Fire monitors should be pointed towards the cargo manifold in use and left in a suitable condition for hands-off operation.

On chemical tankers, where cargo hose connections may be made in a location that is remote from the manifold, a primed fire hose should be laid out in the vicinity together with appropriate portable foam equipment.

The foam of the fixed foam system should be compatible with the majority of cargoes the vessel is allowed to carry. Crews should be aware if the foam on board their ship is compatible with both the product being transferred and with the type of foam on board the vessel alongside.

3.10.8 Electrical storms

When an electrical storm is present or imminent in the transfer area, the cargo transfer operation should be suspended and all vent risers, cargo systems and inert gas systems (IGS) secured until such time as it is considered safe to resume operations.

3.10.9 Galley stoves

Before permitting the use of galley stoves and other cooking appliances while a ship is engaged in STS operations, the ship's Master and the STS Superintendent (if applicable) must, after taking into consideration the location, construction and ventilation of the galley, jointly agree that no associated danger exists. Oil or gas fired stoves or electrical appliances using exposed elements should not be used.

3.10.10 Accommodation openings

Regulations require that windows and portholes in the superstructure within a certain distance of the cargo area must not open, and that openings are positioned to minimise the possibility of vapour entry. These design features must not be modified in any way.

All doors (except when being used for access), portholes and other openings should be kept closed during cargo operations. Accommodation doors that have to be kept permanently closed when in port or at sea for security and safety purposes should be clearly marked. The location of the unlocked accommodation access door should also be identified. Such access doors should be on the opposite side of the accommodation to that of the STS operation.

The accommodation space should be kept under positive pressure to prevent the entry of flammable or toxic vapours. Should vapours be present, action should be taken to minimise the ingress of vapours into the engine room and accommodation spaces.

3.10.11 Unauthorised craft

No unauthorised craft should be allowed alongside vessels involved in STS transfer operations.

Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Communications

Section 4

4.1 General communications

Maintaining good communications between the ships involved is essential for successful ship to ship (STS) transfer operations. Methods of communication, including back-up systems and emergency communication procedures, should be clearly defined and tested before operations commence.

The ships should establish initial communication as early as is practical to plan operations and to confirm the transfer area.

4.2 Language

A common language for communication should be agreed before operations commence to ensure that all vessels can adequately communicate to maintain a safe standard of operation throughout. Reference should be made to *Standard Marine Communication Phrases* (reference 15).

Should a language problem become evident, operations should be suspended until a competent person, fluent in the common language and the language of the vessel on which the problem exists, is in attendance.

4.3 Pre-arrival communications

The STS organisers generally provide pre-arrival information to nominated ships. The STS organiser may be the operator of the ships if carrying out in-house operations, or may be an STS service provider. Normally such providers send advance STS instructions to the ships concerned.

Due to the different circumstances and individual requirements of various STS organisers, it is not practical to provide a generic STS information message. However, the following advice may be useful.

4.3.1 *Information required from the ships*

The following information should be received from involved ships:

- Confirmation of the integrity of systems e.g. navigational, machinery, steering gear, cargo system, crude oil washing (COW), inert gas system (IGS), fire-fighting, mooring equipment, derrick or cranes, etc.
- Confirmation of estimated time of arrival (ETA) at agreed intervals.
- Confirmation that copies of the *Ship to Ship Transfer Guide* and appropriate accepted industry guides (see section 3.1) are on board and that ship's personnel are conversant with the procedures within them.
- Cargo details, including copies of the material safety data sheets (MSDS).
- Confirmation of arrival draught, freeboard and height of manifold above waterline, including anticipated changes during the transfer.
- Confirmation that the ship complies with applicable local, national and international requirements, including those relating to hours of work/rest.

In addition, the organiser should request an electronic copy of the ship's approved STS operations plan, if available (see appendix A1.5). The requirement for an STS operations plan is mandated for vessels undertaking STS transfers of *MARPOL* Annex I cargoes. It is also recommended that similar plans are available on vessels transferring other cargo types.

4.3.2 *Advice to be given to the ships by the ship to ship organisers*

The following information should be provided to involved ships:

- The STS organiser's full title and contact numbers.
- A description of the planned STS operation, including the location of the transfer area.

- Details of equipment (including confirmation of integrity of hoses, fenders, etc), logistical support and personnel to be provided.
- Requirements for the preparation of moorings, manifolds and lifting gear.
- Local and national STS regulations, where applicable.
- Identity of the STS service provider and/or STS Superintendent, where applicable.

In addition to the previous advice, the STS organiser may consider sending electronic copies of the following to the ship:

- A copy of risk assessments identifying appropriate mitigation measures to ensure the safe conduct of the STS at the scheduled transfer area.
- If available, a copy of the joint plan of operation (JPO).

For transfers involving Annex I cargoes reference should also be made to appendix A4.3.2, and for those involving chemical cargoes, reference should also be made to appendix B4.3.

4.4 Navigational warnings

Before commencing an STS transfer operation at sea, and then at intervals according to local requirements (or more frequently if the situation warrants it) the STS Superintendent, or a designate, should broadcast navigational warnings to all ships advising:

- Names of the ships involved.
- Geographical position of operations.
- Nature of operations.
- Time of starting operations and expected duration.
- Request for wide berth.

On completion of the transfer operation, the navigational warning should be cancelled.

For operations conducted in port, local requirements may address the need for navigational warnings, their content and responsibilities for their broadcast. The requirements may also include associated provisions for traffic control.

4.5 Communications during approach, mooring and unmooring

As the ships come into the transfer area, contact should be established on the appropriate very high frequency channel (VHF) at the earliest opportunity, thereafter switching to a mutually agreed working channel. Approach, mooring and unmooring should not be attempted until proper effective communication has been confirmed between the two ships. Prior to commencing the approach, both vessels should confirm that checklists 2 and 3 have been satisfactorily completed. Ship's officers responsible for mooring stations should be provided with portable radios.

Confirmation should be sought that the portable radios on each ship are capable of working on the same frequency. In the event that a common frequency is not available, provision should be made to exchange compatible equipment between the ships.

It is recommended that internal communications on each ship are maintained on separate frequencies to avoid misunderstandings when operations are being conducted on multiple vessels. In addition, all radio transmissions should be prefixed with the vessel's name.

When conducting operations in port, there may be a need to communicate with additional parties such as the port authority, a terminal, pilots, tugs and line handlers.

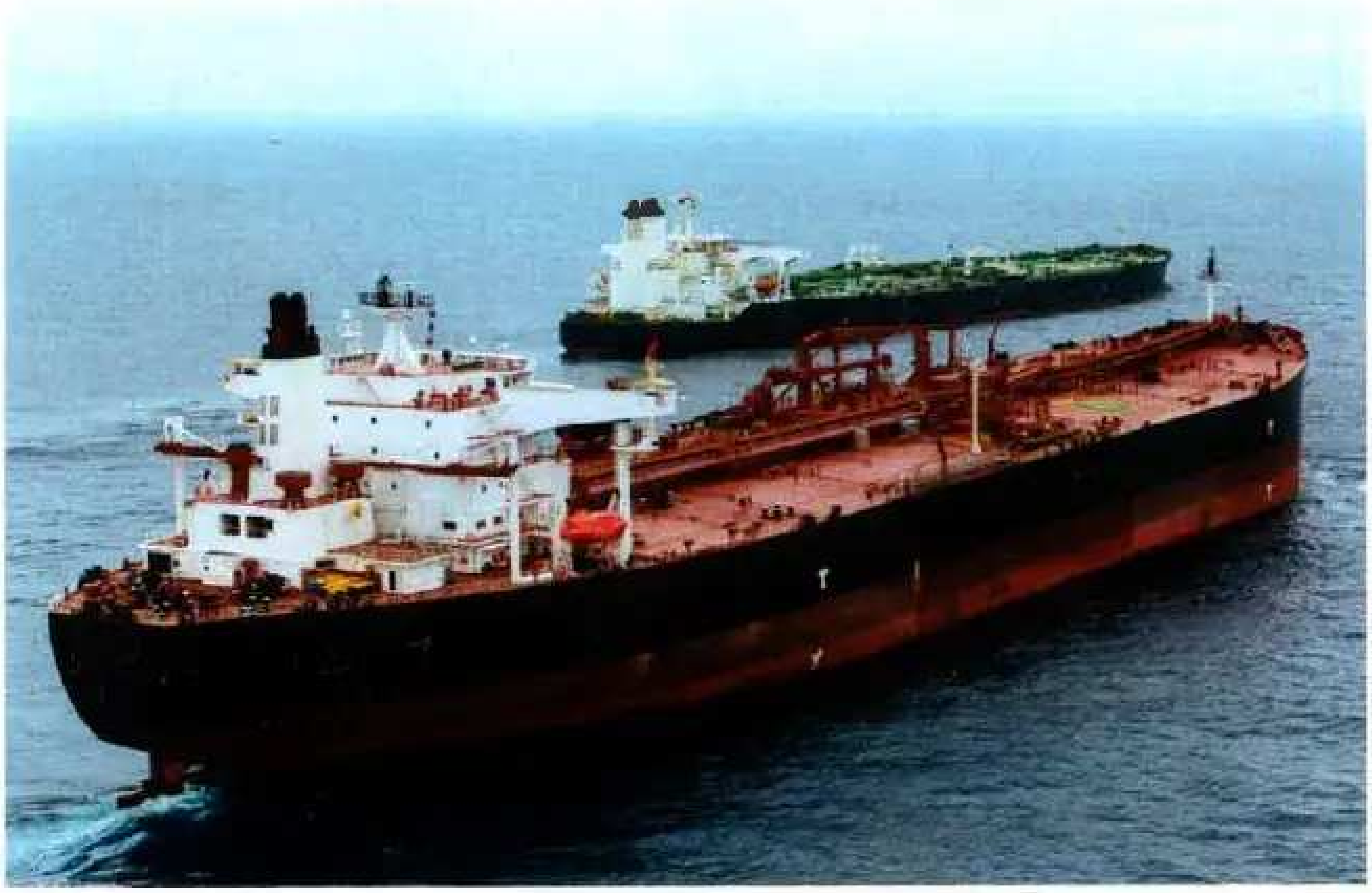

Figure 4.1: Ships manoeuvring on final approach

4.6 Communications during cargo transfer operations

During cargo operations, essential personnel should have a reliable, common means of communication at all times, including an agreed back-up system. It is recommended that spare radios and batteries are available.

When undertaking operations in port, frequencies should be assigned by the STS Superintendent, having due regard for the safety and working channels of the port.

Communications between ships should be regularly tested.

When conducting STS operations at sea, bridge watches should be maintained in accordance with recommendations contained in the *Bridge Procedures Guide* (reference 19).

As appropriate, bridge watchkeepers should maintain communication with:

- The STS Superintendent.
- Deck officers on all involved ships.
- Harbour authorities to provide any required notifications of vessel movements and operations taking place.
- Lightering support craft and other vessels, such as tugs and port safety vessels.

4.7 Procedures for communication failure

If the primary communication system fails at any time during the STS operation, the agreed back-up system should be used.

If communication breakdown occurs during an approach manoeuvre the manoeuvre should be aborted, if appropriate and safe to do so, and the subsequent actions taken by each ship should be indicated by the appropriate sound signals as prescribed in the *International Regulations for Preventing Collisions at Sea (COLREGS)* (reference 14).

During cargo operations, in the event of a total breakdown of communications the emergency signal (see section 10.2) should be sounded and all operations in progress should be suspended.

Operations should not be resumed until satisfactory communications have been re-established.

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Operational preparations

Section 5

5.1 General

Where the ship to ship (STS) transfer operation is to be undertaken at sea, passage plans should include reference to relevant navigational charts and publications. The passage plan should detail the projected track lines for the approach phase to the mooring operation, the required sea room, the planned anchor position, anticipated track lines if drifting, potential navigational hazards and awareness of territorial boundaries (if applicable) and prohibited zones.

5.2 Joint plan of operation

Prior to commencement of any STS operation a joint plan of operation (JPO) should be developed to ensure that all parties involved, including the STS service provider, are in alignment with regard to how the operation is to be conducted.

In all cases the person in overall advisory control (POAC), STS Superintendent or transfer organiser should establish agreement and consensus between all parties.

The JPO should include a compilation of information from various sources. For a particular location, a generic template may be used. Information may include the following:

- Details regarding rendezvous location and designated lightering area, including relevant risk assessment(s).
- Brief description regarding how the STS operation will be conducted, for example approach and mooring underway or with one vessel at anchor, transfer at anchor or underway, unmooring with one vessel at anchor or while underway.
- Details regarding any local or government regulatory requirements and mandatory notifications.
- Communication protocols.
- Security requirements.
- Procedures associated with any personnel transfers.
- Details regarding any service craft and launches.
- Environmental operating parameters/limits for each stage of the STS operation. These should include environmental and operational limits that would trigger suspension of the transfer operation and disconnection and unmooring of the vessels.
- Fender configuration and rigging arrangements.
- Mooring plans and arrangements and sequence of running lines, including use of any specialist mooring equipment.
- Details of transfer and associated equipment, including the number, type and dimensions of cargo (and where applicable vapour) hoses and method of rigging/support.
- Maximum and minimum draught and freeboard anticipated during operations, including details of the stage of operations they relate to.
- Emergency and spill containment procedures.
- Sequence of actions in case of spillage of cargo.
- Co-ordination of plans for cargo hose connection, draining, purging and disconnection, as appropriate.
- Detailed unmooring sequence.

For double banking operations, the suitability of the berth and strength of mooring points should be confirmed (see section 6.5)

In addition, the JPO should include details of the cargo transfer plan(s) or make reference to their content (see section 7.3).

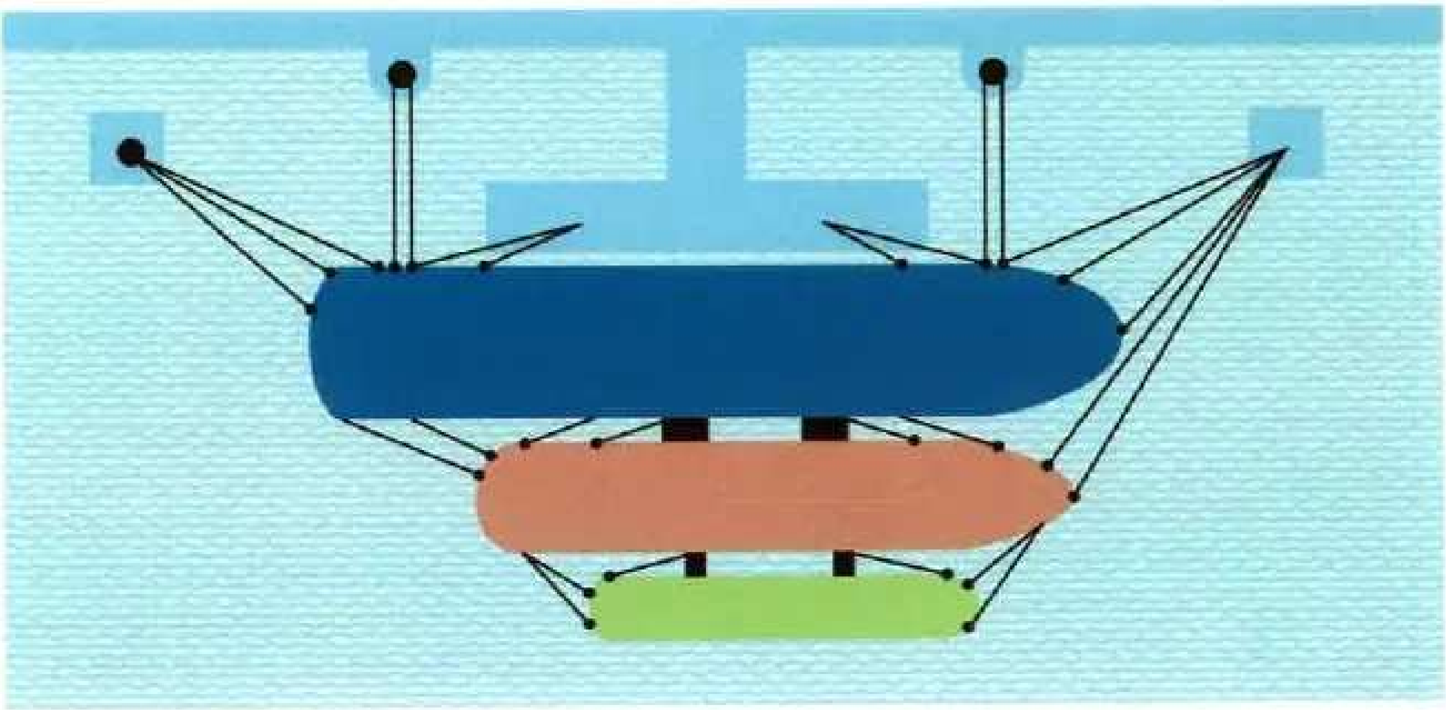


Figure 5.1: Example mooring plan for multi-vessel chemical transfers

5.3 Preparation of ships

The Masters of involved ships should make the following preparations as early as is practical:

- Review the operation-specific risk assessments and, where applicable, the related JPO and ensure all identified preventive and mitigation measures have been implemented.
- Ensure familiarity with the procedures contained in this Guide, supplemented by any instructions issued by ship operators or organisers.
- Confirm that ships will be able to comply with the requirements of the relevant checklists.
- Train and brief crews on procedures and hazards, with particular reference to mooring and unmooring.
- Confirm that steering gear and all navigation and communications equipment is in working order.
- Test engine and thruster controls and main propulsion plant ahead and astern.
- Test essential cargo and safety equipment.
- Confirm that each ship is upright, at a suitable trim with the propeller fully immersed. If one vessel has a list, the possibility of safe stand-off distances being compromised should be considered.
- Prepare mooring equipment, including messengers, in accordance with the agreed mooring plan.
- Ensure that fenders and transfer hoses are correctly positioned, connected and secured as appropriate and as detailed in the JPO.
- For specialised lightering vessels, confirm that fender davits are in the stowed position.
- Prepare cargo manifolds and hose handling gear.
- Obtain area weather forecasts for the transfer period.
- Confirm actions to be taken if the agreed emergency signal is sounded.
- Confirm the security level at which the ship is operating in accordance with the provisions of the *International Ship and Port Facility Security (ISPS) Code* (reference 13), and the requirements being undertaken on board to ensure compliance.

The working sides of ships should be partially or fully cleared of elements of anti-piracy barriers that could risk injury to personnel or the fouling or entanglement of mooring lines.

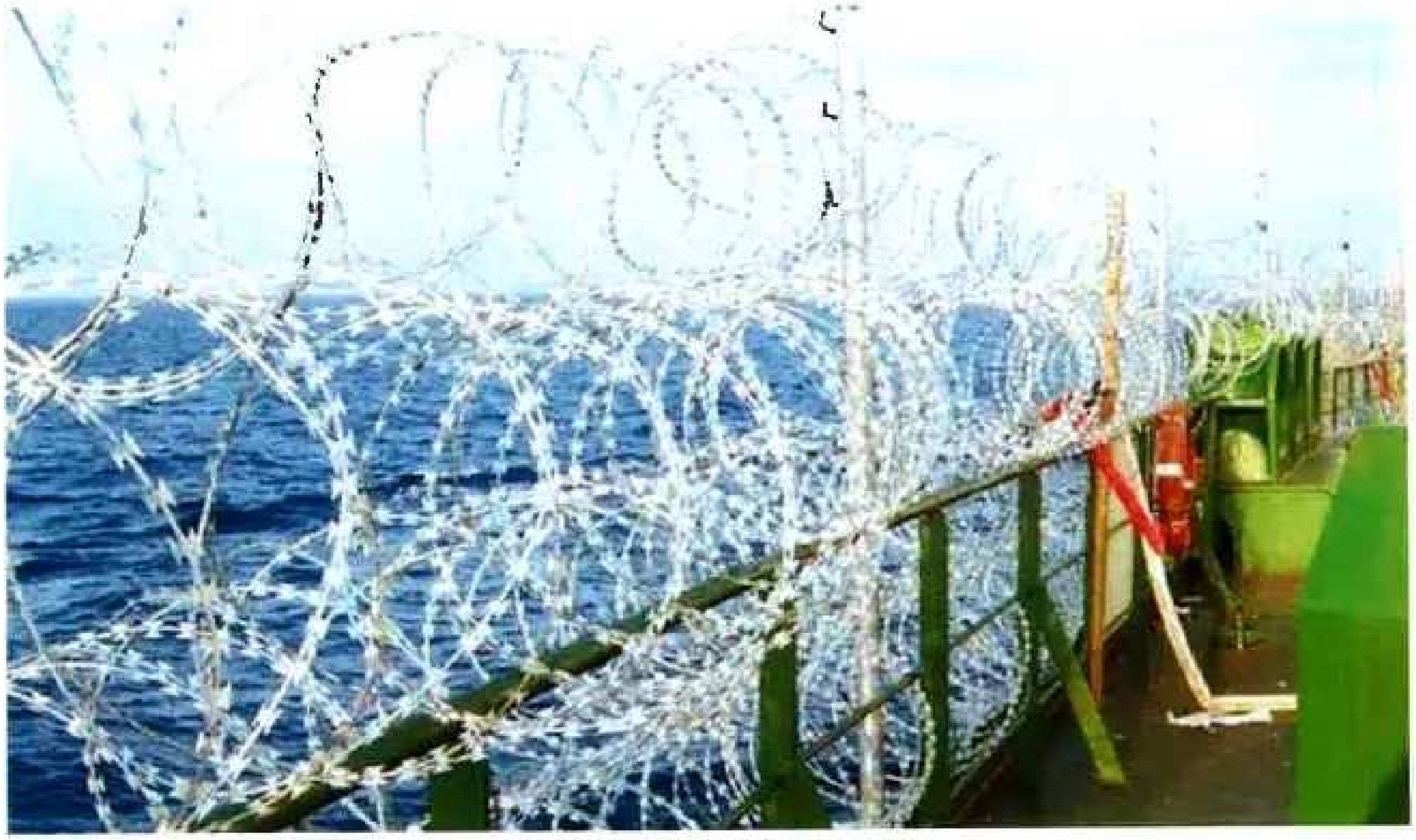


Figure 5.2: Example of anti-piracy barrier

5.4 Lightering support vessels

Lightering support vessels are often employed to transport equipment and personnel to the STS location and to assist in preparing vessels for the operation. If they remain on station once the ships are alongside, the support vessels may assist in ensuring the security and safety of the operation.

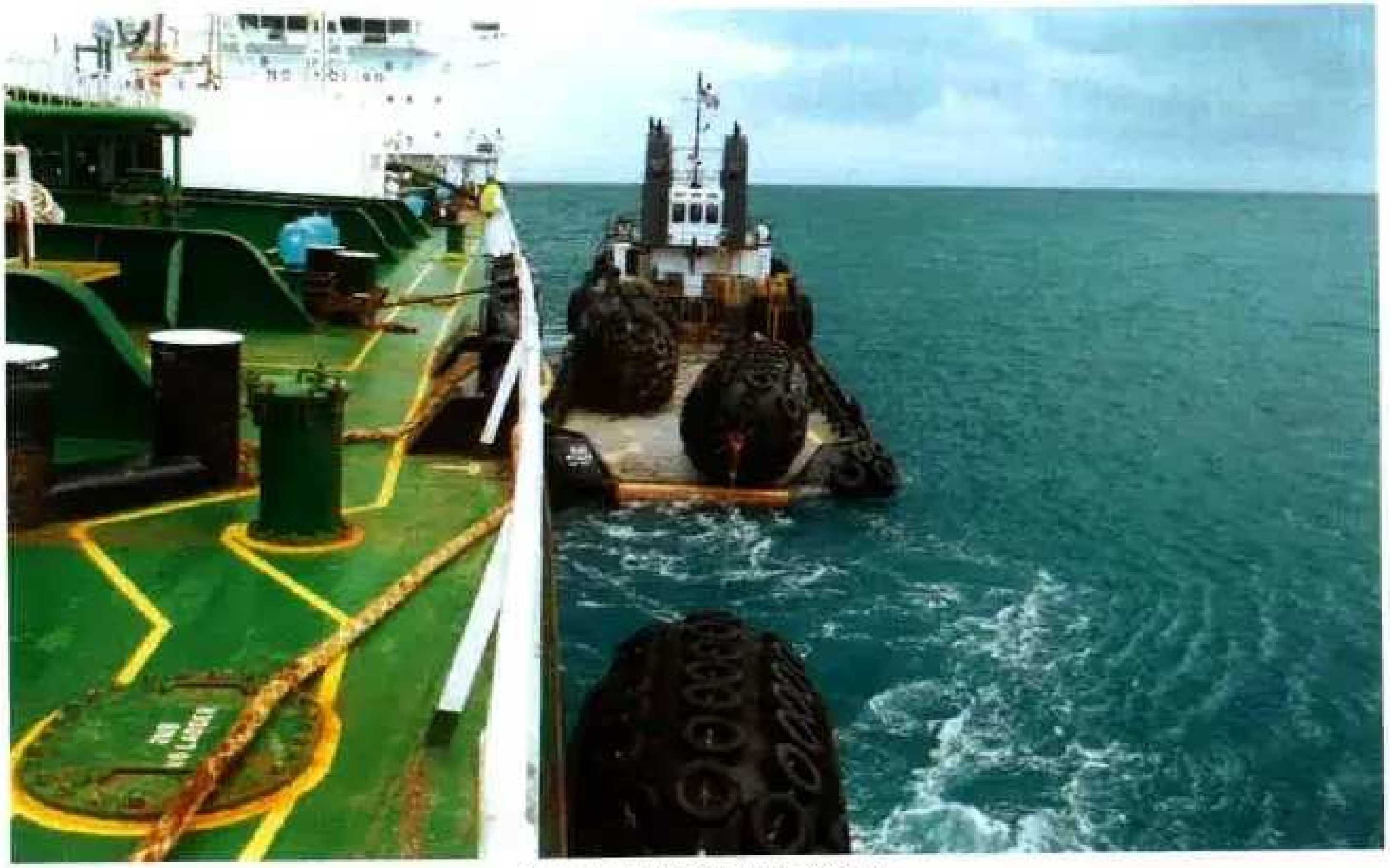


Figure 5.3: Lightering support vessel

In addition to providing operational support for activities such as the rigging of fenders, hoses and specialised mooring equipment, personnel on the support vessel will have roles that may include the following:

- Maintenance of a radio watch on the agreed marine very high frequency (VHF) channels and/or internal communication frequencies.
- Communicate and agree with tanker Masters on the approach manoeuvres alongside.
- An agreed standby position, in the vicinity, while vessels are manoeuvring and while STS operations are underway.
- Maintenance of a good lookout, both visually and by radar, for approaching vessels.
- Making contact with vessels likely to encroach upon established safe areas.

5.5 Navigational signals

During STS transfer operations, the lights and shapes to be shown, and the sound signals to be made, are those required by the *International Regulations for Preventing Collisions at Sea (COLREGS)* (reference 14), and local regulations. Lights and shapes should be checked and rigged ready for display prior to the STS operation.

Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Manoeuvring and mooring

Section 6

6.1 Basic principles

Manoeuvring, mooring and unmooring operations should take into account any local regulations and the output from risk assessments. Due consideration should be given to any restrictions that may be posed by factors that include restricted visibility or the adequacy of vessel lighting for operations during the hours of darkness.

At some locations, particularly within port limits, manoeuvres may be subject to local requirements and may involve the use of pilots and tugs (see section 6.4).

6.2 Manoeuvring alongside at sea with two ships under power

One of the two ships, normally the larger, maintains steerage way at slow speed (typically about knots) keeping a steady course heading. Local conditions and knowledge will dictate the appropriate heading, with due regard to the guidance in sections 2.3 and 2.4. The manoeuvring ship then manoeuvres alongside.

The berthing operation should take into account the manoeuvring characteristics of the ships. For example, if the manoeuvring ship is fitted with a right handed propeller, when going ahead the impact of transverse thrust will typically result in the manoeuvring ship approaching and berthing with her port side to the starboard side of the constant heading ship.

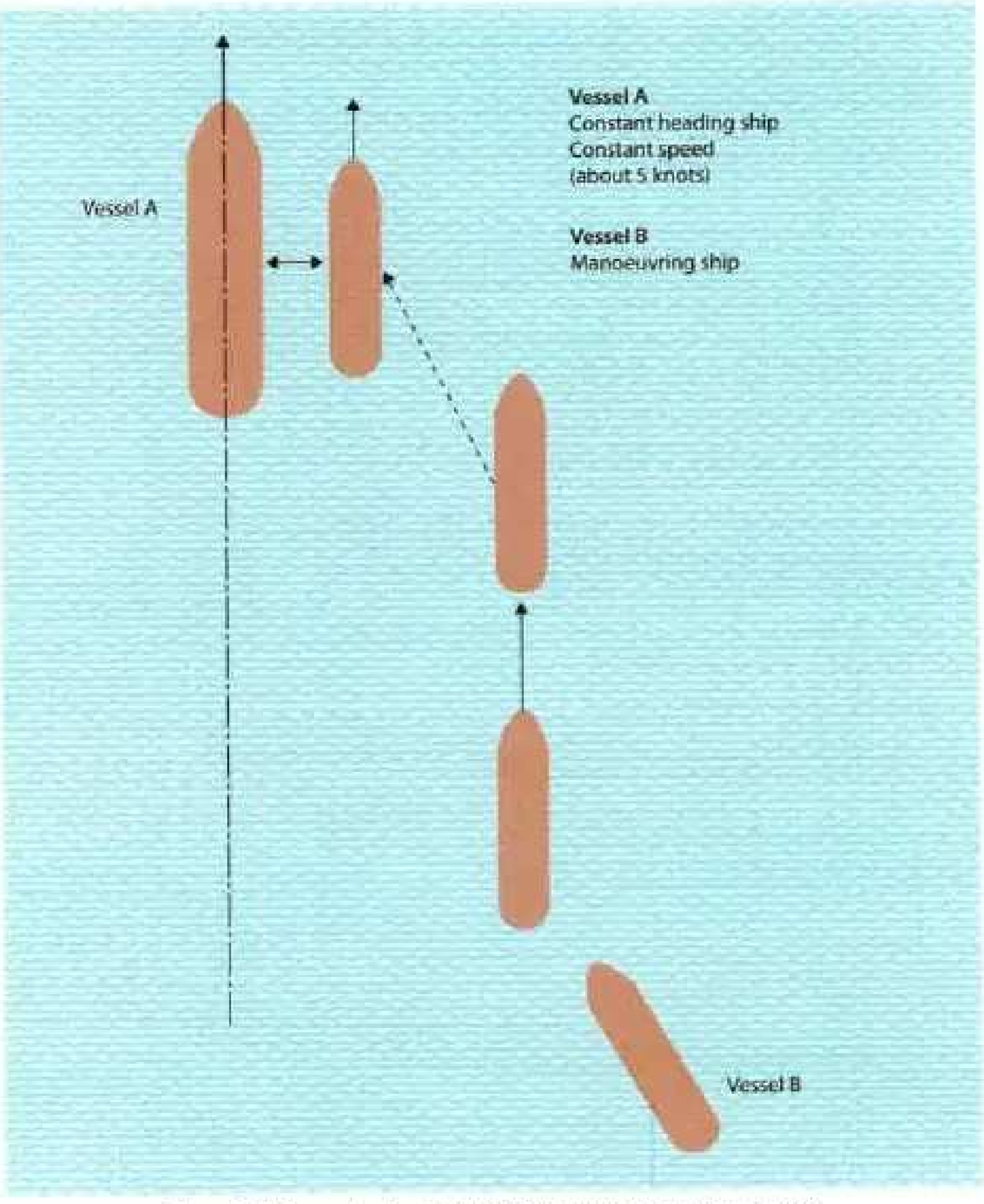


Figure 6.1: Example of a possible final approach manoeuvre at sea

A common method of berthing is for the manoeuvring ship to approach the constant heading ship from the quarter on the side of berthing. On closer approach the manoeuvring ship should parallel the course of the constant heading ship at a safe distance appropriate to the prevailing conditions, then position itself relative to the constant heading ship with the manifolds on both ships being almost abreast of each other. The manoeuvring ship reduces the distance by appropriate rudder and engine movements, keeping the manifold stations on both ships abreast of each other until parallel contact is made with the fenders, at which point both ships are proceeding at the same speed through the water (see figure 6.1).

6.2.1 *General advice for controlling the two ships*

Each ship should take the following into account:

- All navigation and communications equipment should be in full working order and proficient helmsmen should be used.
- Engine movements and steering gear should be remotely controlled from the bridge.
- Courses and speeds requested by the manoeuvring ship should be followed by the constant heading ship. A common system for assessing speed should be agreed, such as speed through the water or over the ground.
- Where possible, the ship's speed should be controlled by adjusting engine revolutions or propeller pitch. This will facilitate fine adjustments, for example plus or minus 5 revolutions per minute (RPM), rather than the relatively coarse control possible using the engine room telegraph. In the absence of the ability to remotely adjust engine revolutions, the telegraph will need to be used and information concerning the engine revolutions for set telegraph positions should be communicated before commencing the approach.
- On motor ships, the number of available air starts should be ascertained.
- At night the deck should be adequately lit and, if possible, the ship's side and fenders should be illuminated.
- The side for mooring should be clear of all overside obstructions.
- There should be effective radio communications between the bridge and mooring personnel on each ship. Communications should be tested before commencing the approach and agreement reached on a back-up method in the event of a communication failure (See sections 4.3 and 4.5).
- There should be effective communications between the bridge teams of each ship. This should be maintained on a separate frequency to those being used for internal radio communications on each ship.

6.2.2 *Advice for manoeuvring alongside*

The following points should be considered when manoeuvring alongside:

- If either of the Masters of the ships or the STS Superintendent has the slightest doubt about the safety of the manoeuvre, the berthing operation should be aborted.
- At all times, each ship is responsible for maintaining a proper lookout.
- During manoeuvring, the manoeuvring characteristics of the involved ships together with local conditions and/or knowledge will indicate an optimum approach. Common approaches include:
  - Keeping the wind and sea on the port bow of the constant heading ship.
  - Keeping the wind and swell on the port or starboard quarter of the constant heading ship to reduce loads on the fender rigging and to reduce the relative wind across the deck.
- The angle of approach adopted by the manoeuvring ship should not be excessive.
- The RPM of the main engine(s) of the constant heading ship are normally set to provide a speed through the water as requested by the STS Superintendent or Master of the manoeuvring ship. No changes should be made without advising the STS Superintendent or Master of the manoeuvring ship.
- When manoeuvring at close quarters the effect of ship interaction should be anticipated. To ensure optimum helm response to counter the effects of interaction and to maintain effective heading control, the manoeuvring ship should keep her engines turning ahead or, if fitted with a controllable pitch propeller, maintain positive propeller pitch throughout.
- Ships that are nominated to conduct underway STS operations should be capable of manoeuvring at slow speeds of 5 knots or less. In situations where the manoeuvring ship has a relatively high minimum speed, the STS Superintendent may consider increasing the speed of the constant heading ship sufficiently to enable the manoeuvring ship to complete the berthing operation without the need to temporarily stop its engine to reduce speed though the water. In doing so, it must be borne in mind that the effects of interaction increase as the square of the ship's speed through the water. In addition, any limitations posed by loads on

fender rigging should be considered.

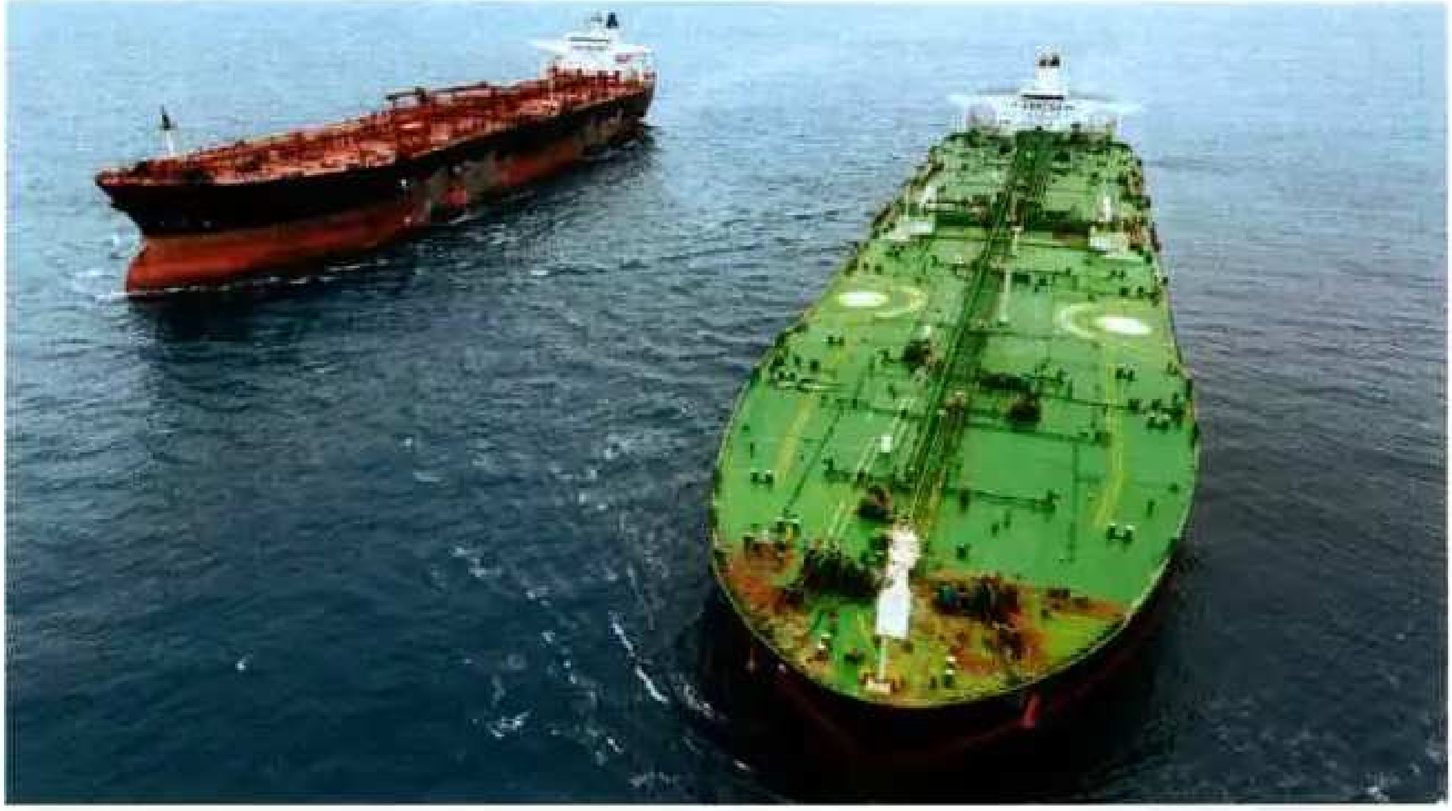


Figure 6.2: Approach manoeuvre at sea

6.2.3 Manoeuvring a combined two ship system to anchor

On completion of mooring, the constant heading ship will usually power all future manoeuvres and, if a transfer at anchor is planned, will proceed to the agreed anchoring position. During this time the (former) manoeuvring ship will have its engines stopped and rudder amidships. It should be emphasised that, during this period, to avoid problems for the manoeuvring ship the constant heading ship should not use excessive engine movements, particularly excessive astern movements when anchoring. Speeds through the water should be minimal.

The constant heading ship should use the anchor on the side opposite to that on which the other ship is moored.

Once at anchor, each ship is responsible for watchkeeping arrangements as required by the *International Convention on Standards of Training Certification and Watchkeeping for Seafarers (STCW)* (reference 9). Nothing relieves a ship of the requirement to keep a navigational watch.

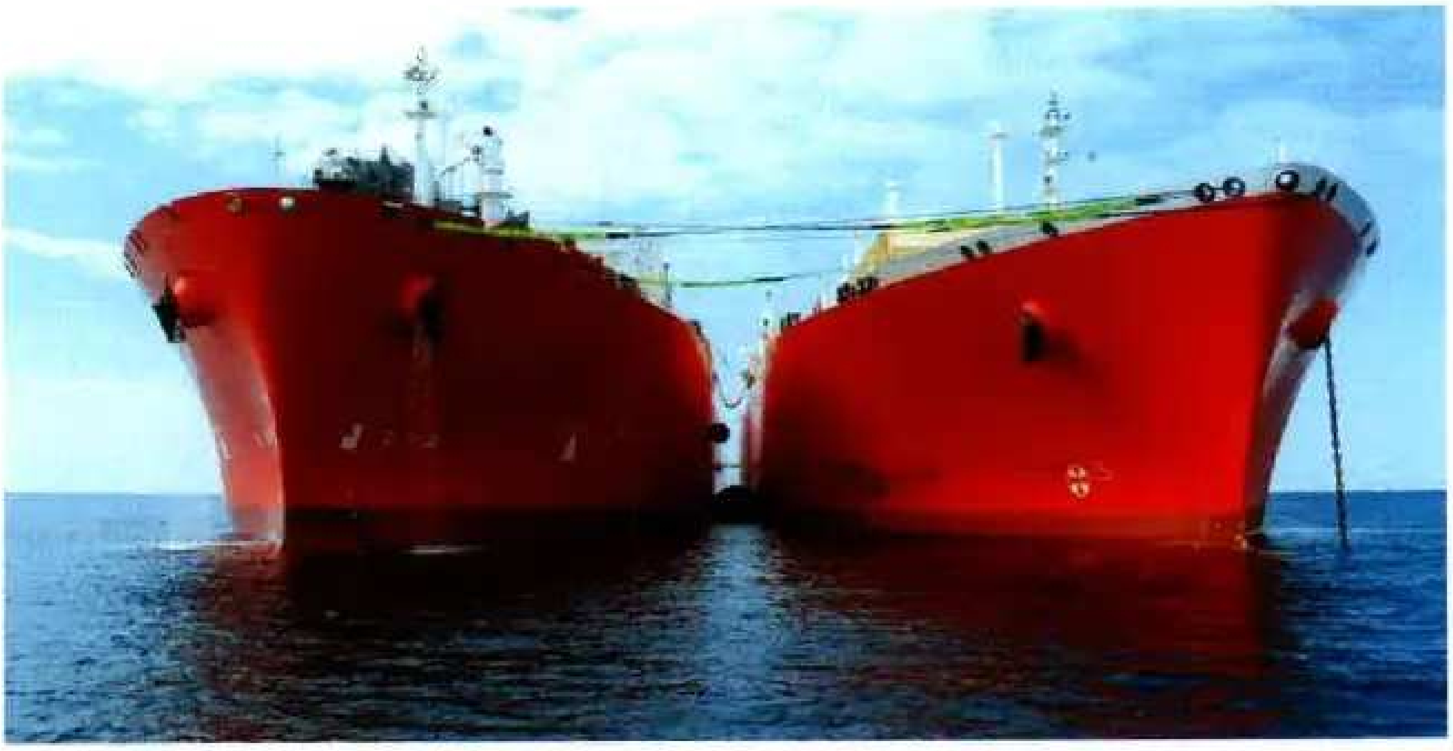


Figure 6.3: Ship to ship transfer operation at anchor

6.2.4 *Underway transfer*

Local conditions, such as those where water depths are too great for anchoring, sometimes demand that cargo transfer be carried out with the two ship system under power and making way through the water. As long as adequate sea room is available and traffic conditions, weather, sea conditions and forecasts are suitable, then transfers of this type can be carried out. Where applicable, vessels should be manoeuvred within the limits of any designated lightering area. It should be noted that speeds through the water should be minimal, as appropriate to the prevailing conditions.

The constant heading ship normally maintains steerage way at slow speed on a steady course and the (former) manoeuvring ship remains with engines stopped as a towed ship. To minimise towing loads on the moorings, the constant heading ship should alter her engine revolutions sparingly, adjusting speed very gradually. The chosen course and speed should be agreed by the two Masters and the STS Superintendent and should result in minimum relative movement between the two ships and minimum turbulence in the gap between the hulls.

Alternatively, for some ships having a low speed manoeuvring capability, such as dedicated lightering ships fitted with a variable pitch propeller or diesel electric propulsion, the manoeuvring ship may be the towing ship. Under such circumstances, appropriate mooring arrangements should be in place, such as the provision of additional backsprings.

While the ships are moored together as a unit, both vessels should maintain a safe navigational watch.

Provided conditions are suitable and the transfer area is of a suitable size, consideration may be given to carrying out the cargo transfer with the two ships drifting freely.

If deteriorating weather conditions cause the ships to roll unacceptably, engine and rudder movements may be used to bring the ships to a heading that results in minimum movement.

Care should be taken to protect fenders and their associated rigging from head-on seas and swell. This may necessitate a change of heading to place the wind and seas off the bow.

6.3 Manoeuvres with one ship at anchor

STS transfer operations involving one ship already positioned at anchor are common. For such operations, one ship anchors in a pre-determined position using the anchor on the side opposite to that on which the other ship will moor. In addition to the usual factors that have to be taken into account when deciding on the scope of cable (water depth, holding ground, winds, currents and underkeel clearance), the Master of the ship that is to anchor should also allow for the fact that the single anchor will be required to hold both ships.

A berthing operation should only be carried out after the anchoring ship is brought up to her anchor and is lying on a steady heading with reference to prevailing current and wind conditions. Berthing should not be attempted when the tidal stream is due to change.

A careful watch should be kept on the heading of the anchored ship and the anchored ship should advise the manoeuvring ship immediately if she has any tendency to yaw. Where there is a tendency to yaw excessively, a tug should be employed to hold the anchored ship on a steady heading. If no tug is available, postponement of the operation should be considered.

A risk assessment should be undertaken by the organisers to evaluate the necessity of tug assistance for the manoeuvring ship. Where current and wind are not from the same direction, or the wind varies in speed or direction, the anchored ship can yaw (or lie cross-current), making it difficult for the manoeuvring ship to berth alongside. Also, both ships could experience differing effects due to their different freeboards and draughts. In these circumstances tug assistance may be advisable to hold the anchored ship on a steady heading during berthing.

It is recommended that the services of an experienced STS Superintendent or local pilot are utilised for this type of operation. For operations undertaken in port, local regulations should be observed and these may include the use of pilots, tugs and line handlers.

During hours of darkness, consideration should be given to ensuring that the night vision of the approaching vessel is not hindered by bright deck lights and other background lighting. As advised by the approaching vessel, it may be necessary to temporarily switch-off or angle away the deck lighting of the anchored ship.

6.4 Manoeuvring for in port operations

Many STS operations, particularly those associated with the transfer of chemical products, are undertaken within port limits. These operations may involve berthing alongside the discharging ship, which may be at anchor in sheltered waters or alongside a terminal (see section 6.5). Permission of the harbour authorities and, where required, the terminal should be obtained prior to commencing manoeuvres to berth alongside another vessel. The STS Superintendent should be aware of the estimated time of arrival (ETA) of the vessels and should be notified when manoeuvres are about to commence.

The manoeuvring vessel should advise the Master of the moored ship of the intended approach and the approach should not be commenced until the procedure has been jointly agreed.

Within port limits, it will in most cases be a requirement to take a berthing pilot on board and, depending on the size of the vessel, regulations may require that tugs are used.

6.5 Manoeuvring with one ship alongside a terminal

This operation, also known as double banking, involves one or more vessels mooring alongside a ship that is already moored to a jetty and is a relatively common practice in certain trades.

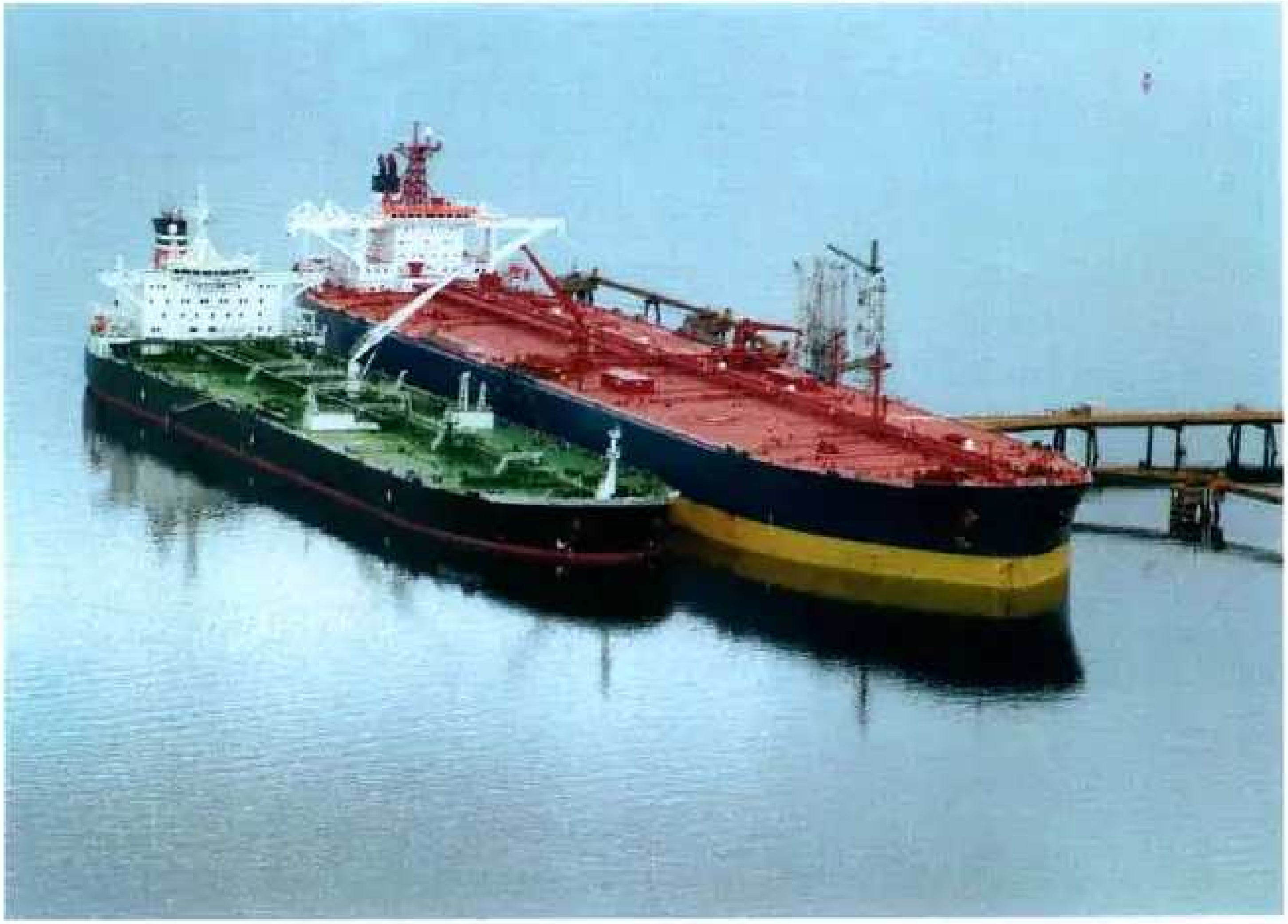


Figure 6.4: A double banking operation

Figure 6.4: A double banking operation

For berths that have not traditionally been used for double banking operations, it is recommended that a formal engineering study and risk assessment is undertaken and a formal procedure and safety plan is produced prior to conducting such operations.

Before double banking operations are agreed, consideration and agreement should be reached by all parties concerned on issues that may include the following:

- Safe arrival and departure procedures.
- Integrity of the berth, including fender panels and mooring fittings, with regard to the potential loads involved.
- Personnel access, including emergency escape provisions for personnel on all involved ships.
- Management of operational safety.
- Roles and responsibilities of involved parties.
- Contingency planning, fire-fighting and emergency unberthing.

The Master of the ship moored to the terminal should be aware of the total displacement of his ship and vessels berthing alongside. The mooring arrangements should be adequate for the anticipated loads.

Consideration should be given to the availability and need for line handling support. The ship alongside the terminal may provide crew to receive and secure the line but this should not detract from the safety of any ongoing cargo operations. Local port regulations may require that licensed line handlers are used and these should be arranged prior to commencement of manoeuvring.

6.6 Mooring operations

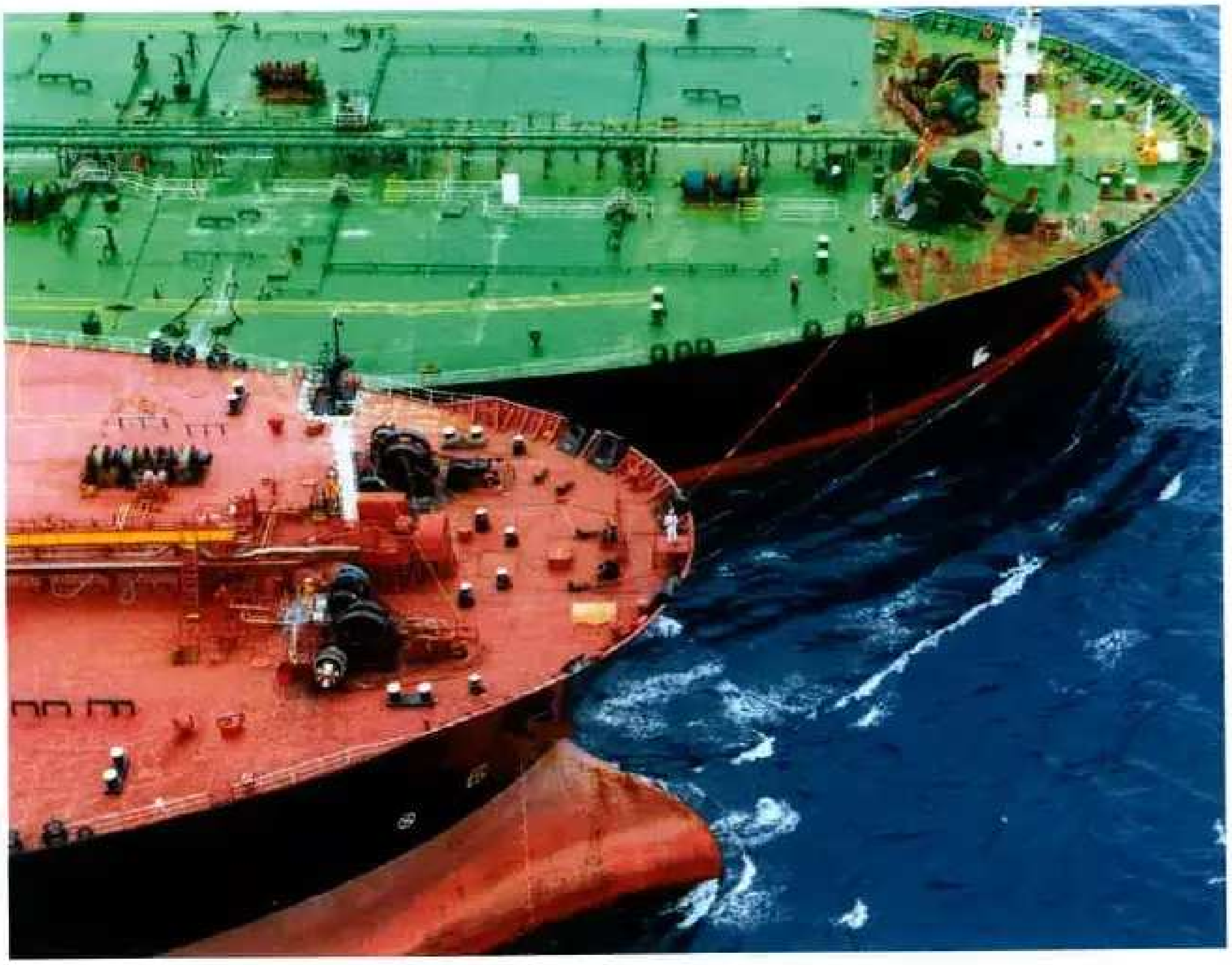


Figure 6.5: At sea mooring operation

Figure 6.5: At sea mooring operation

6.6.1 Mooring plans

The mooring plan adopted for a particular STS operation will depend upon the size of each ship and the difference between their sizes, the expected difference in freeboards and displacement, the anticipated sea and weather conditions, the degree of shelter offered by the location and the efficiency of mooring line leads available. Most STS service providers will have a standard mooring plan, suitable for the particular location. It is important to ensure moorings allow for ship movement and freeboard changes to avoid over-stressing the lines throughout the operation. These should not be so long that they allow unacceptable movement between the ships. Mooring lines leading in the same direction should be of similar size and material.

STS transfer operations, by their very nature, create situations where two ships are moored close alongside each other with considerable differences in freeboard. The steeper the orientation of the mooring lines, the less effective they will be in resisting horizontal loads. The maximum anticipated freeboard difference should therefore be taken into account when planning the mooring layout to ensure that the vertical angle of each mooring line stays as small as practicable throughout the operation.

As a general guide, figure 6.7 illustrates a typical and proven mooring arrangement plan for an STS transfer operation in offshore waters.

6.6.1.1 *Mooring analysis*

To support the risk assessment of a transfer location (see section 3.2.1), consideration may be given to conducting a mooring analysis modelling the range of ship sizes likely to be conducting STS operations at the location.

The mooring analysis should be conducted for ships in laden, partially laden and ballast conditions using environmental data corresponding to those identified for the region from metocean studies.

The results of the mooring analysis should be used to determine the following:

- Safe environmental operating limits for STS operations.
- Nominal speeds and directions for ships to proceed with respect to defined prevailing wind, sea and swell conditions to moderate ship movement and minimise dynamic loads and wear on mooring equipment, fenders and other ship systems, including cargo transfer equipment and cargo containment structures.
- Optimum criteria and methodology for aborting transfer operations and separation of ships.
- Selection and/or configuration of mooring system components to maximise their effectiveness.
- Selection and rigging of fenders to maximise their effectiveness.

6.6.2 At sea mooring operations

Mooring operations should be managed to ensure prompt and efficient mooring line handling. Rope messengers should be made ready between fairleads and deck winches. Moorings should be arranged and rigged to allow safe, effective line tending when the ships are secured together.

Suitable rope messengers should be made ready on both ships and, in addition, rope stoppers should be rigged in way of relevant mooring bitts. Where possible, heaving lines and rope messengers should be made of buoyant materials. A minimum of four messengers should be provided and ready for immediate use. For large ship operations, it is recommended that messengers of 40 mm diameter are employed.

Lines should only be led through closed fairleads suitable for STS operations (see section 9.3).

Mooring lines should be deployed in accordance with the mooring plan. When prevailing weather conditions or weather forecasts require it, additional lines should be deployed. It is recommended that no more than two mooring lines are placed through each chock and secured on a set of bitts.

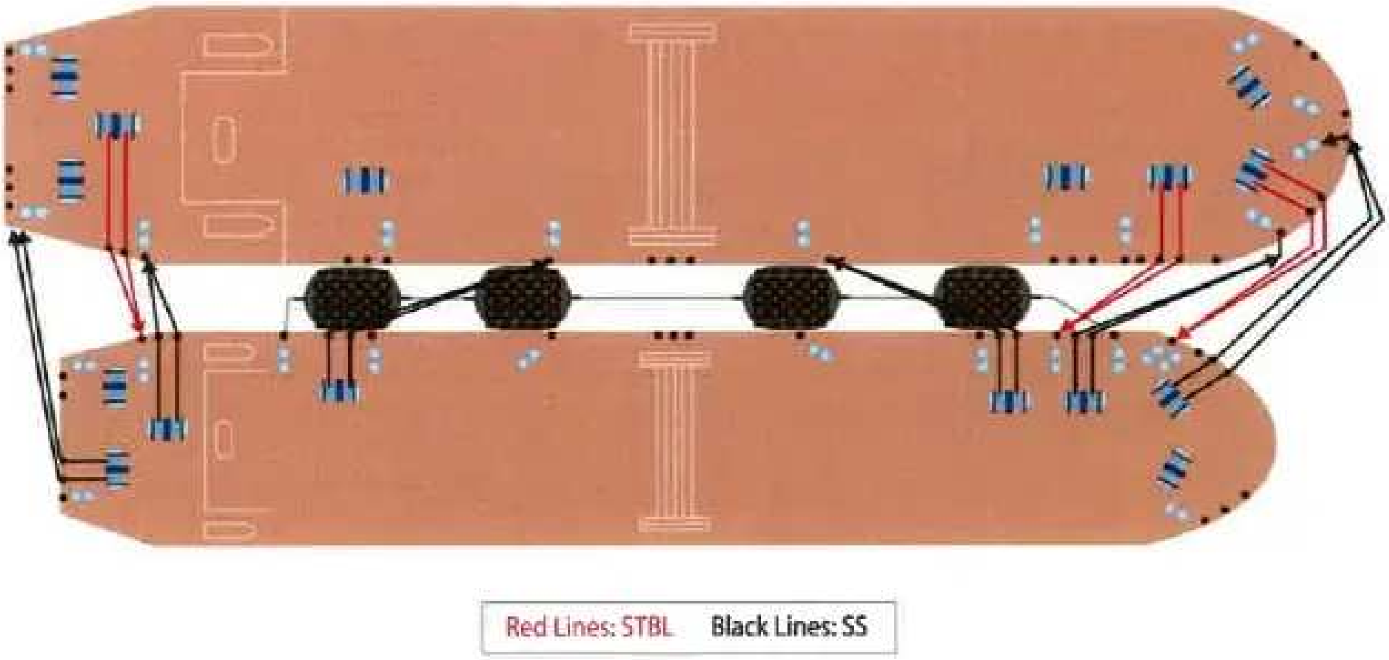


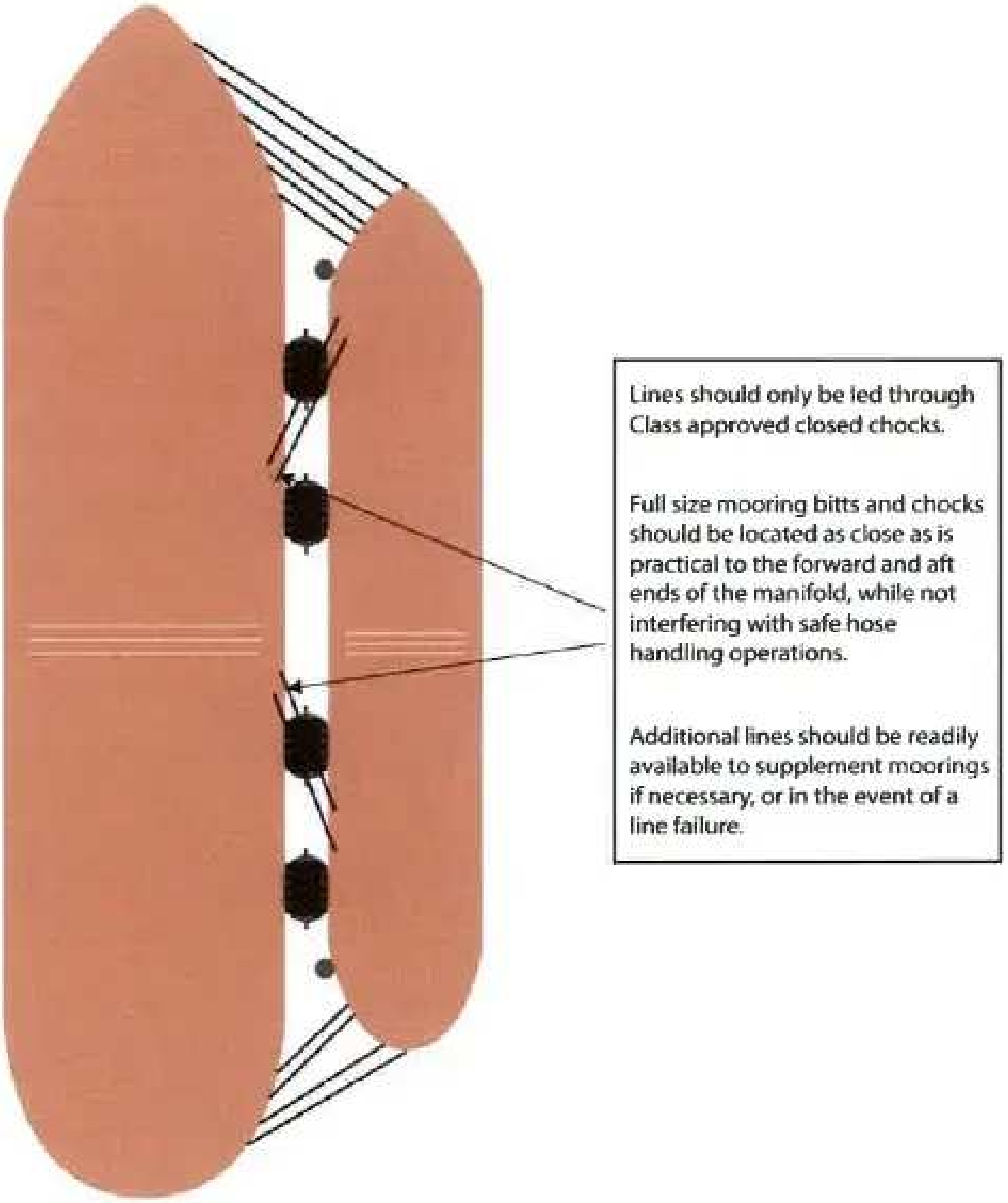
Figure 6.6: Example of a ship to ship mooring plan, including contingency unmooring arrangements

The order of passing mooring lines during mooring, and of releasing lines during unmooring, should be agreed. Where the STS service providers utilise quick release mooring arrangements, their role and use should be discussed to ensure proper understanding.

At any time, spare lines should be readily available to supplement moorings if necessary or in the event of a line failure. While analysis of mooring loads alone may indicate a lesser number of mooring lines would be sufficient, it is prudent to provide for some redundancy. However, where specialised mooring equipment is fitted (e.g. on a dedicated lightering ship) the number of head lines could be reduced where this has proven to be reliable for the local operating environment.

During the transfer operation, freeboard differences should be kept to a minimum, with consideration given to ballasting the higher ship and de-ballasting the lower one where this is possible. Initial ship selection criteria should be considered carefully where large freeboard differences may become significant.

On completion of mooring it is recommended that messengers are prepared and positioned ready for unmooring in line with the unmooring plan. Their ready availability may save time in an emergency.



Lines should only be led through Class approved closed chocks.

Full size mooring bitts and chocks should be located as close as is practical to the forward and aft ends of the manifold, while not interfering with safe hose handling operations.

Additional lines should be readily available to supplement moorings if necessary, or in the event of a line failure.

Figure 6.7: Typical ship to ship mooring arrangement plan for seagoing tankers

Non-pyrotechnic line throwing equipment may be used to make the first connection. Crews should be advised beforehand and further warned immediately before the equipment is used.

Figure 6.8: Pneumatic line thrower

To facilitate mooring and umooring operations, some operators employ a system that utilises a grommet and loop arrangement, sometimes known as a Double D. An example of this is shown in figure 6.9 and includes the optional use of a wire pennant to prevent chafing damage to the synthetic tail in way of the fairlead. Care should be taken, when using wire pennants through fairleads that may be used for High Modulus Poly-Ethylene (HMPE) moorings, to avoid damaging the fairlead's surface (see section 9.3).

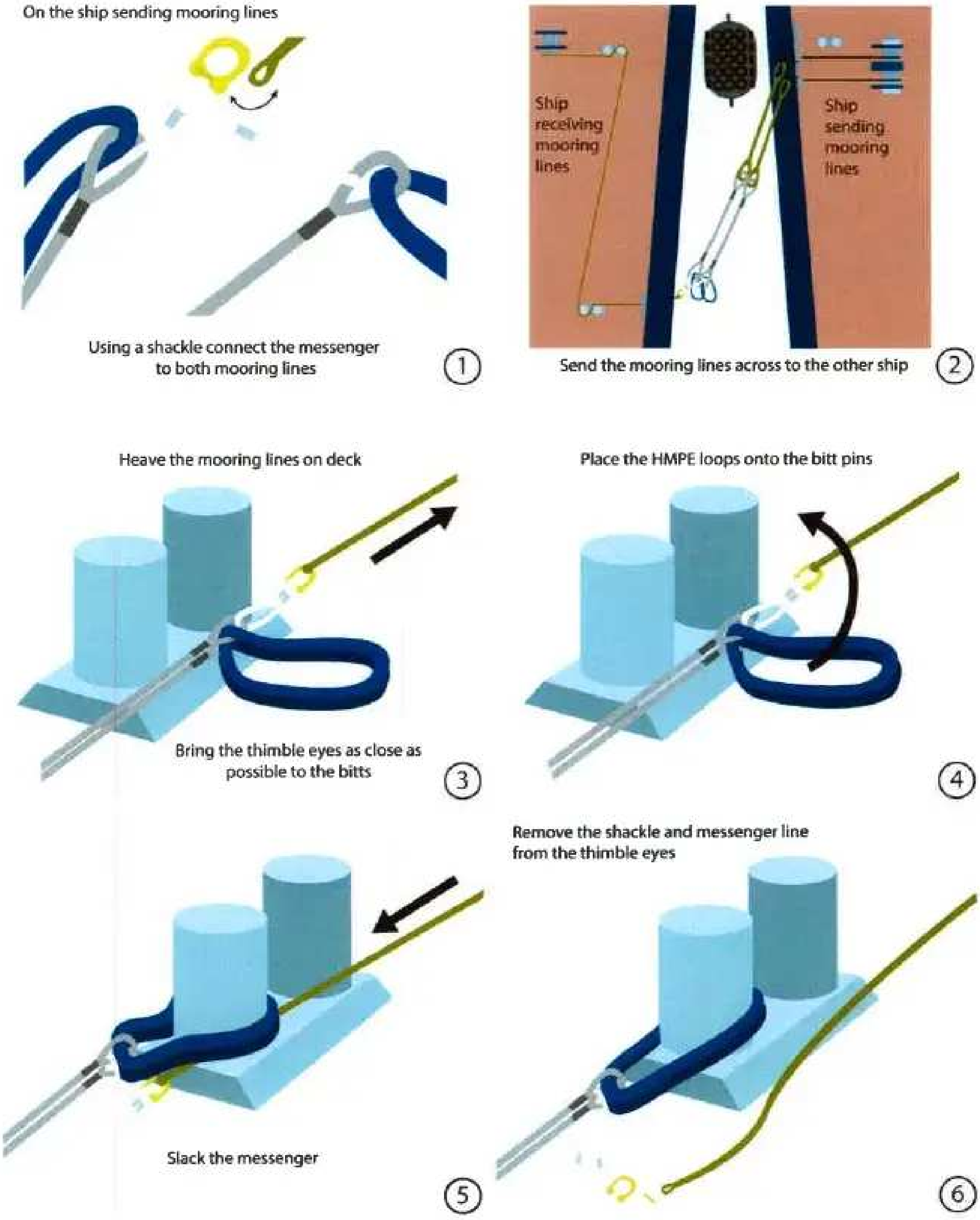

On the ship sending mooring lines
Using a shackle connect the messenger to both mooring lines
①
Ship receiving mooring lines
Ship sending mooring lines
Send the mooring lines across to the other ship
②
Heave the mooring lines on deck
Bring the thimble eyes as close as possible to the bitts
③
Place the HMPE loops onto the bitt pins
④
Slack the messenger
⑤
Remove the shackle and messenger line from the thimble eyes
⑥

Figure 6.9: Securing the line on board using a Double D arrangement

6.6.2.1 *Efficiency of ship to ship mooring systems*

Tension in mooring lines

Excessive or uneven tension in mooring lines should be avoided because it can significantly reduce the weather threshold at which the forces in mooring lines will exceed their operating limits. Attention should be given to this throughout the STS operation in order to ensure changes to the relative freeboards do not create excessive strain in the moorings.

Mooring line lead angles

Peak loads on individual head and stern mooring lines can be minimised if the lead angles are similar and more effectively sharing the mooring loads.

Weather thresholds

In general, higher weather thresholds for mooring loads can be tolerated when the mother ship is at or close to fully loaded displacement. Masters and STS Superintendents should be aware that weather thresholds may change significantly during the course of an STS operation as the mother ship is lightered. It is also apparent that a larger mother ship can be expected to have a higher mooring load weather threshold than a smaller one.

Long period waves and swell

STS operations in locations subject to long period waves should be undertaken with caution. The load on mooring lines at any specific significant wave height greatly increases as the wave period, or period of encounter, increases.

A long period swell will result in a greater rolling motion between the two ships. Care should be exercised when planning a turn in a long period swell to prevent moorings being over-stressed.

Direction of wave encounter

Wave encounter from a beam direction during STS operations should be avoided. This will need particular attention when using exposed anchorage STS locations that are subject to strong currents, where the ships can lie at a large angle to the wind and waves.

When conducting underway STS operations, the optimum wave encounter direction to control mooring loads is commonly considered to be from the quarter, with the larger ship to windward. However, depending on the relative size and displacements of the two ships, this may not always be the case. For instance, when both ships are of similar size and as the receiving ship's displacement increases relative to the discharging ship, the optimum mooring load wave encounter direction may change to the starboard bow, with the receiving ship lying to windward. In such a case it may be advantageous to have sea room available for course alterations across the wind.

Elasticity of mooring arrangement

Nylon tails of 11 metres in length are recommended to improve the elasticity of the mooring arrangement (see section 9.3). Under certain circumstances in exposed locations, longer tail lengths may improve the overall integrity of the mooring system.

Chafing protection

Synthetic moorings passed through shipside fairleads may be subjected to chafing from cyclical loading due to the vessel's motion. Lines can be protected with suitable chafing covers. The covers may be lubricated to minimise the potential for them being damaged (see figure 6.10).

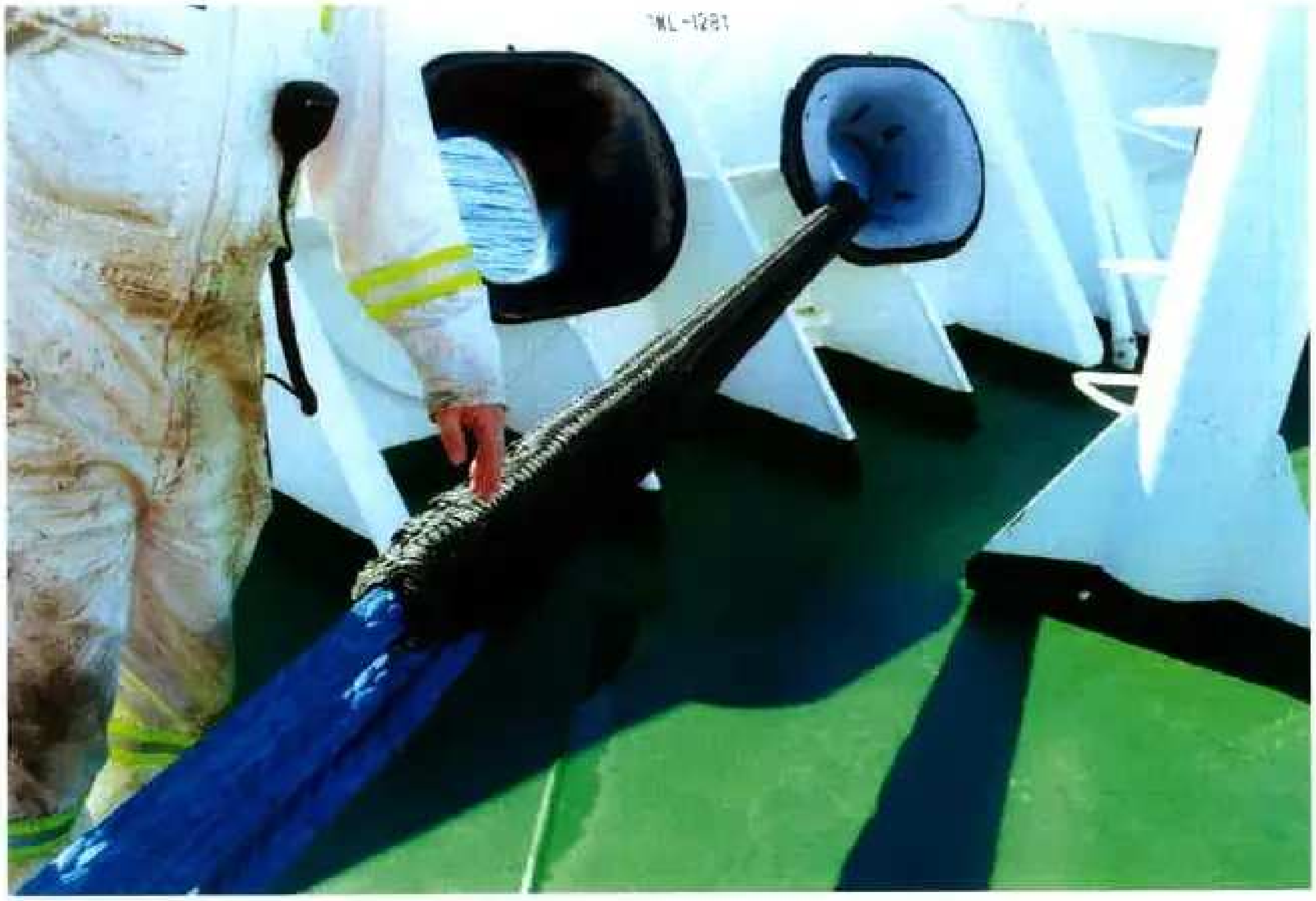


Figure 6.10: Chafing protection fitted to High Modulus Poly-Ethylene mooring line

6.6.3 *In port mooring operations*

The mooring configuration should be discussed and agreed in advance between the mother ship and vessels expected alongside so that crews have adequate notice to prepare the moorings and to ensure that there is no confusion as to when the mooring ropes will be sent out, and from which location.

STS transfer operations will often involve mooring alongside vessels with a higher freeboard and it is recommended that all lines are led through closed fairleads to avoid the possibility of lines jumping out of the lead.

All mooring lines should be passed through fairleads and be secured to bitts, bollards or cleats with an adequate safe working load (SWL).

Off-shore anchors may often be used as an aid in controlling the approach to a ship that is moored alongside. A sufficient length of cable should be used to provide the necessary drag force.

Bow and stern thrusters, when fitted, should be used to full advantage. Consideration should be given to the effects that the use of the thrusters may have on the mother ship and any other vessels alongside.

The first lines sent to the mother ship will usually be the spring lines, followed by the head and stern lines. Should the springs lines be used to assist in bringing the vessel alongside, due consideration must be given to the impact on the mother ship and the added force being placed on her moorings.

Every effort should be made to prevent chafing of the mooring lines at the chocks or fairleads of both vessels. The moorings should be checked and tended regularly to ensure proper tension is maintained throughout the transfer operation.

Mooring plans should anticipate and allow for the effects of port traffic passing in close proximity to the transfer location.

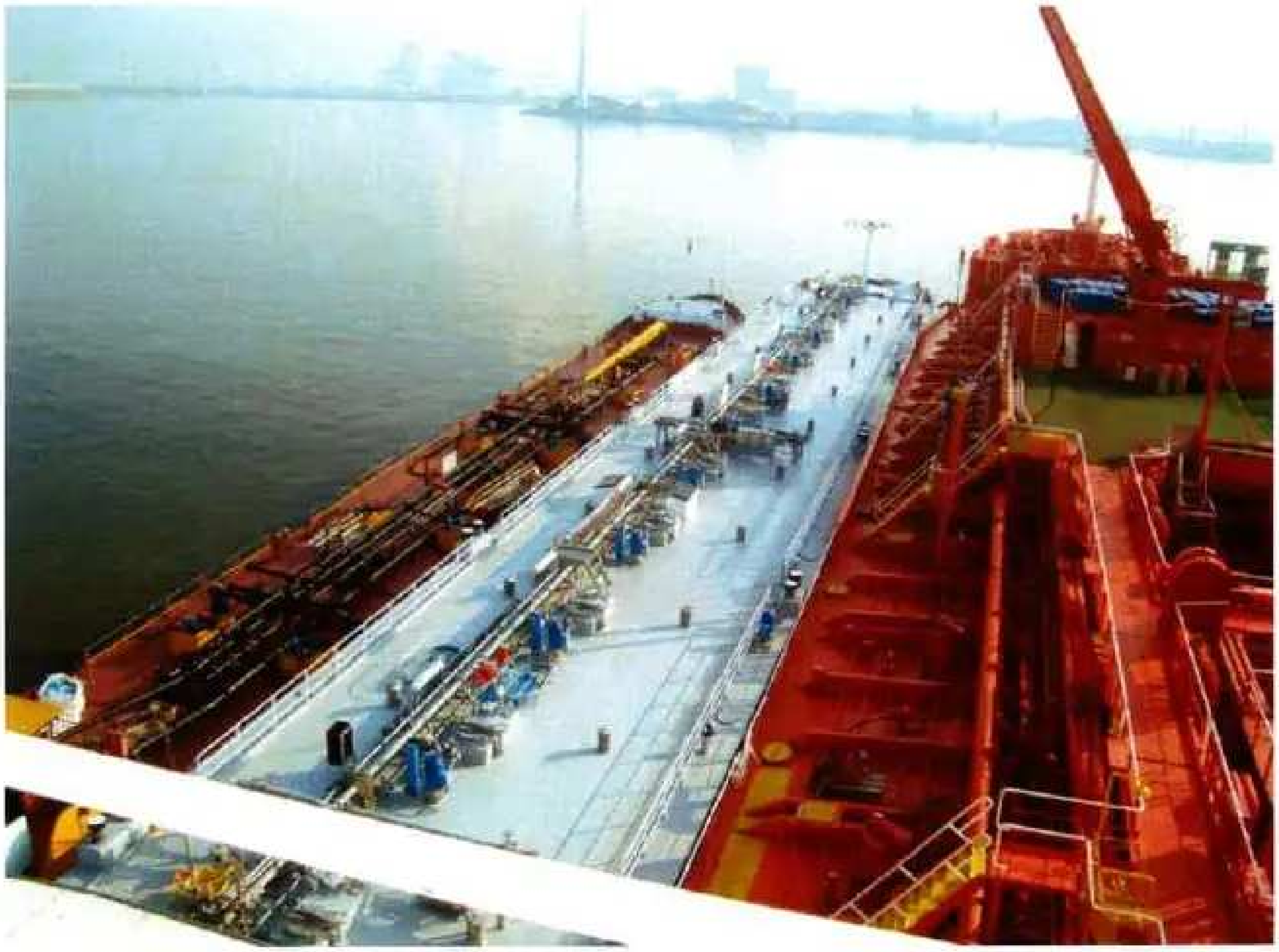


Figure 6.11: Multiple vessels alongside a mother ship

Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Procedures alongside

Section 7

7.1 Pre-transfer procedures

When the two ships are securely moored, and before cargo transfer commences, good communications should be established between the personnel responsible for cargo operations on each ship and the pre-transfer checks should be satisfactorily completed (see appendix E, checklist 4 or 6). In addition, attention should be given to the joint completion of the appropriate pre-transfer safety checklist.

7.2 Responsibility for cargo operations

Cargo transfer operations should be jointly agreed and take into account any limitations imposed by involved vessels and the transfer equipment. Where applicable, details should be included within the joint plan of operation (JPO) (see section 5.2).

The person in charge of the cargo operations for each ship should be positively identified and this information exchanged with the other ship. This information is normally included on an allocated duties list posted on the bridge, cargo control room (CCR) and engine control room (ECR), which shows titles, locations and duties of all persons involved in the ship to ship (STS) operation at various times.

In addition, an emergency duties list may be similarly posted showing titles, locations and duties of all persons that would be involved should an emergency situation occur.

Where applicable, a copy of the ship's approved STS operations plan should also be available on the bridge, CCR and ECR.

Appendix D7.2 contains guidance on minimum manning levels for supervising liquefied natural gas (LNG) cargo transfer activities.

7.3 Planning for cargo transfer

When preparing cargo loading and discharging plans, due regard should be given to ensuring that adequate stability is maintained, hull stresses remain within limits and free surface and sloshing effects are considered. It should be recognised that transfer operations may have to be suspended at any time, due to weather for example.

Particular care should be taken to ensure that operational compliance with the relevant damage stability requirements is verified. Consideration should also be given to including verification of both intact and damage stability requirements at the planning stage.

The cargo transfer operation should be planned and agreed in writing between the two ships and, where applicable, should include information on the following:

- Means of communication.
- Expected duration of operation.
- Watch or shift arrangements and measures to prevent fatigue.
- Quantity of each grade of cargo to be transferred.
- Sequence of grades, cargo density, temperature and specific precautions such as those that might be necessary for toxic, flammable and static accumulating products.
- Supply and compatibility of transfer hoses and equipment, including insulating arrangements.
- Details of cargo transfer system, number of pumps and maximum permissible pumping pressure. For gas carriers, cargo tank and piping max/min design temperatures, capacity of vapour handling system and emergency shutdown (ESD) arrangements.

- Details of tank washing, including crude oil washing (COW).

- Cargo heating requirements.
- Details of vapour management.
- The time required by the discharging ship for starting, stopping and changing rate of delivery during topping-off of tanks.
- Rate of cargo transfer during operations (e.g. initial, maximum and topping-off as appropriate).
- Agreed stopping and emergency shutdown signals and procedures.
- Disposition and quantity of ballast and slops, including disposal.
- Emergency and spill containment procedures.
- Local or government rules that apply to the transfer.
- Material safety data sheets (MSDS) information in respect of the cargo to be transferred and, if applicable, the receiving ship's previous cargo.
- Co-ordination of plans for cargo hose connection, monitoring, draining and disconnection.

Before starting cargo transfer, the discharging ship must be informed by the receiving ship of the flow rates required for the different phases of the cargo operation. If variations in transfer rate become necessary, the receiving ship should advise the discharging ship of its requirements. The discharging ship should, similarly, inform the receiving ship of any variations in flow rates due to its operations.

The agreed transfer rate should not exceed the manufacturer's recommended flow rates for the cargo transfer equipment.

Appendices B7.3 (chemicals), C7.3 (liquefied petroleum gas (LPG)) and D7.3 (liquefied natural gas (LNG)) provide additional guidance relating to transfer planning procedures for the respective cargoes.

7.4 Cargo transfer - general guidance

The receiving vessel should control the cargo transfer operation in line with the requirements of the agreed cargo plan. The discharging vessel should work to facilitate the requirements of the receiving vessel.

Throughout cargo transfer operations the cargo manifold areas of both ships should be observed by a competent person to monitor the status of the hoses. In addition, a responsible person on each ship should be in communication with the other vessel(s) and be able to immediately stop the transfer.

Cargo transfer should begin at an agreed slow rate to enable the receiving ship to check that the cargo pipeline system is correctly set. The transfer rate should also be reduced to the agreed topping-off rate when the receiving ship's tanks are approaching their final ullage or sounding. Throughout the transfer (at least once an hour) transfer rate checks and comparisons should be made between the two ships, and the results logged. Any differences or anomalies should be carefully checked and, if necessary, cargo operations should be suspended until the differences are resolved.

When agreeing the transfer rate, in addition to normal operational considerations account should be taken of factors including, but not limited to, the following:

- Limitations dictated by the cargo transfer equipment.
- Any limitations imposed by inert gas/vapour management systems and by flow velocities in the ships' fixed cargo piping or venting systems.

Cargo operations should be conducted under closed conditions with all ullage, sounding/sampling ports securely closed.

When establishing safe filling levels, due account should be taken of the impact of vessel motions on the accuracy of in-tank ullaging/gauging systems, the operation of independent high level alarms and the potential for the carryover of cargo into vapour systems in the event of over filling.

The incorrect operation of pumps and valves may produce pressure surges that can be sufficiently severe to damage the pipeline or transfer equipment. Consideration should be given to the prevention of pressure surges by careful planning, good communications, effective control of pump speeds and the operation of valves, particularly when topping-off.

Static accumulator cargoes may require extra precautions and recommendations contained in accepted industry codes of practice should be adhered to when handling this type of cargo.

During cargo transfer, appropriate ballast operations should be performed to manage stress and stability and to minimise the differences in freeboard between the ships. Excessive trims should be avoided. Likewise, listing should be avoided except as required for cargo tank draining on the discharging ship. For at sea operations, to ensure full manoeuvring capability, propeller immersion should be maintained throughout the operation.

All ballast operations should be conducted in accordance with the ship's ballast water management plan. Any national or local regulations controlling discharge of ships' ballast water should be complied with.

Constant attention should be paid to mooring lines and fenders to avoid chafing and undue stress, particularly that caused by changes in relative freeboard. If at any time mooring lines or fender pennants need to be re-positioned or adjusted, this should only be done under strictly controlled conditions. Consideration should be given to the need to suspend other operations to attend to these activities.

See appendices B7.4 (chemicals), C7.4 (LPG) and D7.4 (LNG) for additional guidance relating to transfer procedures for the respective cargoes.

7.4.1 Vapour balancing – general considerations

The following guidance is not applicable to transfers involving LPG or LNG.

It may be required that some STS cargo transfers are undertaken in conjunction with vapour balancing. Such operations should only be conducted between inerted ships in accordance with the following:

- Any applicable national or local regulations.
- Guidance contained in the *International Safety Guide for Oil Tankers and Terminals (ISGOTT)* (reference 1) or other relevant industry codes of practice.
- Where applicable, procedures contained in the ship's STS operations plan and/or volatile organic compound (VOC) management plan.

To perform STS operations using vapour balancing, at least one of the ships involved should be provided with oxygen analysis equipment that is set up to draw samples continuously from the vapour manifold connection to which the vapour transfer hose will be connected.

The vapour hose may be a smooth bore hose fitted with flanges that have been drilled to connect to vapour manifolds, and provided with cylindrical studs to prevent mis-connection.

To ensure cargo vapour emissions to the environment are reduced as much as possible during the vapour balancing operation, the following measures to minimise cargo vapour evolution during the operation should be considered:

- Careful operation of cargo handling equipment to minimise cavitation of transfer pumps.
- Minimising use of cargo eductors for stripping and draining.
- Where applicable, keeping COW operations to a minimum.

7.4.1.1 *Vapour balancing considerations before commencing cargo transfer*

- Cargo tank ullage space pressures should be maintained as low as practicable without activating low pressure alarms.
- The inert gas (IG) line should be drained and the vapour transfer hose should be purged and inerted prior to commencing transfer of vapours.
- The vapour manifold valves should not be opened until the pressure in the cargo system of the receiving vessel exceeds that of the ship discharging cargo.

7.4.1.2 *Vapour balancing considerations during cargo transfer*

- It is recommended that, on board both vessels, a portable oxygen analyser is stationed in the vicinity of the manifold area to make periodic checks on the vapour stream independently of the continuous monitoring being conducted.

- The inert gas system (IGS) on the discharging ship should be kept on standby ready for immediate use. The system should be operated if the IG pressure in the discharging vessel falls below a pre-determined value. Positive pressure should be maintained in all cargo tanks of both ships throughout operations.

- The IG pressure on both ships should be monitored and each ship advised of the other's pressure on a regular basis.
- Transfer operations should be suspended if the oxygen content of the vapour stream exceeds 8% by volume and should only be resumed once the oxygen content has been reduced to 8% or less by volume.
- The cargo transfer rate should not exceed the design rate for the vapour hose, as established by the manufacturer.

7.4.1.3 *Vapour hose considerations*

- When connected, care must be taken to ensure that the vapour hose is not kinked anywhere along its length as this may cause significant flow restriction.
- Care should be taken to avoid liquid build-up in the vapour hose due to liquid carry-over from one of the ship's vapour mains or from condensation.

An example checklist for transfers involving vapour balancing is provided as appendix G.

7.5 Operations after completion of cargo transfer

After completion of cargo transfer the following operations should be carried out:

- The cargo transfer equipment, including vapour hoses, should be properly drained prior to disconnecting.
- Cargo transfer equipment should be disconnected and securely blanked.
- Cargo manifolds should be securely blanked.
- Where required, authorities should be informed of completion of cargo transfer and the anticipated time of unmooring.

See appendices B7.5 (chemicals), C7.5 (LPG) and D7.5 (LNG) for additional guidance relating to operations after completion of transfer of the respective cargoes.

7.6 Bunkering and storing

It is not recommended that bunkering takes place at the same time as STS cargo operations. A separate risk assessment should be produced if concurrent bunkering is required.

Bunkering and storing activities should only be undertaken at the same time as the cargo transfer if there are sufficient personnel available to effectively monitor both operations.

Many terminals and harbour authorities do not permit bunkering to take place while cargo hoses are connected.

When transfer operations take place at anchor, storing may be undertaken from a barge or work boat. It should be noted that personnel on the storing vessel are unlikely to be aware of the hazards associated with products being transferred and may require specific briefing on safety and emergency procedures, including use of personal protective equipment (PPE).

With the discharging ship moored alongside a terminal, any storing would have to be across the discharging ship. Usually, this will involve the use of the discharging ship's lifting equipment and should require the consent of the STS Superintendent.

Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Unmooring

Section 8

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8.1 Preparations for unmooring

Prior to unmooring, checklist 5 (see appendix E) should be completed by each vessel and confirmation provided to the other vessel that all items have been confirmed as satisfactory.

The bridge teams and officers on mooring stations on both vessels need to understand the sequence in which lines will be released, and the method of releasing.

If necessary, a broadcast should be made on the appropriate very high frequency (VHF) channel(s) to alert vessels in the vicinity and request a wide berth during the unmooring manoeuvre.

8.2 Unmooring procedure

There is a risk of steel to steel contact during manoeuvres associated with vessel separation and so the operation requires careful planning and execution.

8.2.1 Unmooring after underway transfer

Where STS transfer operations have taken place while underway, options to assist in separating the ships may include:

- Manoeuvring the combined two ship system to position the vessel with the highest freeboard on the downwind side.
- With little or no wind, manoeuvring the ships so that the swell is ahead to assist with separating the bows.

To minimise the effects of interaction, it is recommended that speeds are maintained at a minimum appropriate for the prevailing weather conditions. All moorings should remain on the winch brake until instructions are received from the Master to place winches in gear.

Care needs to be exercised when unmooring to avoid the two ships coming into contact. The sequence of mooring line release should be planned for each individual unmooring operation, taking into account the prevailing weather conditions. The unmooring sequence should ensure that propellers are kept clear. The tension on the mooring lines and compression of individual fenders should be closely monitored throughout. Bows may be brought up into the wind or swell to assist in separating the vessels. The proximity of the aft ends of both vessels and compression on the aftermost fender should be monitored closely as the bows open up. The manoeuvring ship should avoid crossing close ahead of the other vessel. The constant heading ship should not independently manoeuvre until advised that the manoeuvring ship is clear.

It should be noted that local conditions or ship configurations may cause difficulties in separating the two ships and alternative manoeuvres may need to be considered.

8.2.2 Unmooring while one ship is at anchor

This operation may be complicated by the unpredictability of environmental conditions and the difficulty of accurately assessing such factors as tidal conditions and yawing of the anchored ship. It is therefore recommended not to unmoor during a change of tide. It is also recommended that unmooring at anchor be carried out only by persons with considerable experience in STS operations and, where the ship is not fitted with thrusters, the use of tugs should be considered, especially if yawing of the anchored ship is anticipated. If no tug support is available, postponement of the operation should be considered. Alternatively, the anchor should be weighed and unmooring should be carried out while making way.

After singling-up, the controlled slacking of head and stern lines may allow the vessel to part from the anchored ship. Thrusters, main engine movements and rudder angles should be used cautiously, while being fully aware of the effect on the heading of the anchored ship and avoiding any inducement to cause it to yaw

8.2.3 *Unmooring from a ship alongside a terminal*

Where necessary, the permission of the harbour authorities and the terminal should be obtained prior to commencing unmooring operations. Unmooring operations should be conducted in accordance with

[illegible]

procedures agreed by both Masters and particular attention should be given to prevailing weather and tidal conditions.

Where multiple vessels are alongside a mother ship the STS Superintendent should give consent for the unmooring operation and all other vessels should be made aware of the planned departure. This requirement applies equally to the unmooring of unmanned barges.

If unmooring takes place during hours of darkness, consideration should be given to reducing background lighting so as to be fully aware of other vessels and the proximity of navigational hazards, while ensuring that all working areas are adequately and safely lit.

Within port limits, the services of a pilot and tug support may be required by local regulation.

Bow and stern thrusters, when fitted, should be used to full advantage. Consideration should be given to the effects that the use of the thrusters may have on the mother ship and any other vessels alongside.

The mother ship may provide crew to release the lines. However, this should not detract from the safety of any ongoing cargo operations. Port regulations may require that licensed line handlers are used and these must be arranged in advance, to board with the pilot.

Should the spring lines be used for springing off, consideration should be given to the added force likely to be placed on the mother ship's moorings. Secondary fenders should be ready for positioning to prevent contact between the hulls.

8.2.4 *Unmooring using quick release arrangements*

Care should be taken to ensure that the lines are released in an orderly, prompt and efficient and safe manner and do not compromise the ability of either vessel to use their engines for manoeuvring, even in an emergency situation. This operation should be planned in advance and requires good communications and supervision.

Different methodologies can be applied by STS Superintendents and ships' crews to carry out this task safely and effectively. One such method involves the use of quick release hooks secured around the mooring bitt (see figures 8.1 and 9.10) or a toggle pin that is used in conjunction with a messenger to take the load of the mooring line while it is removed from the mooring bitt (see figure 8.2). There are some vessels with quick release hooks permanently mounted on deck and this needs to be taken into consideration in the STS mooring pre-planning stage as well as unmooring.

Moorings attached to quick release hooks should not be released when under load and the lines should be slacked down prior to release.

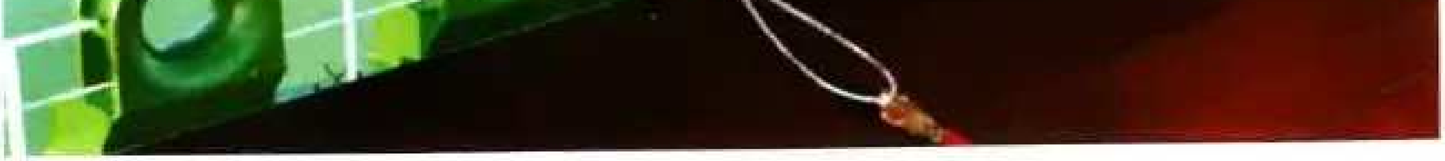

Figure 8.1: Releasing moorings using portable quick release hooks

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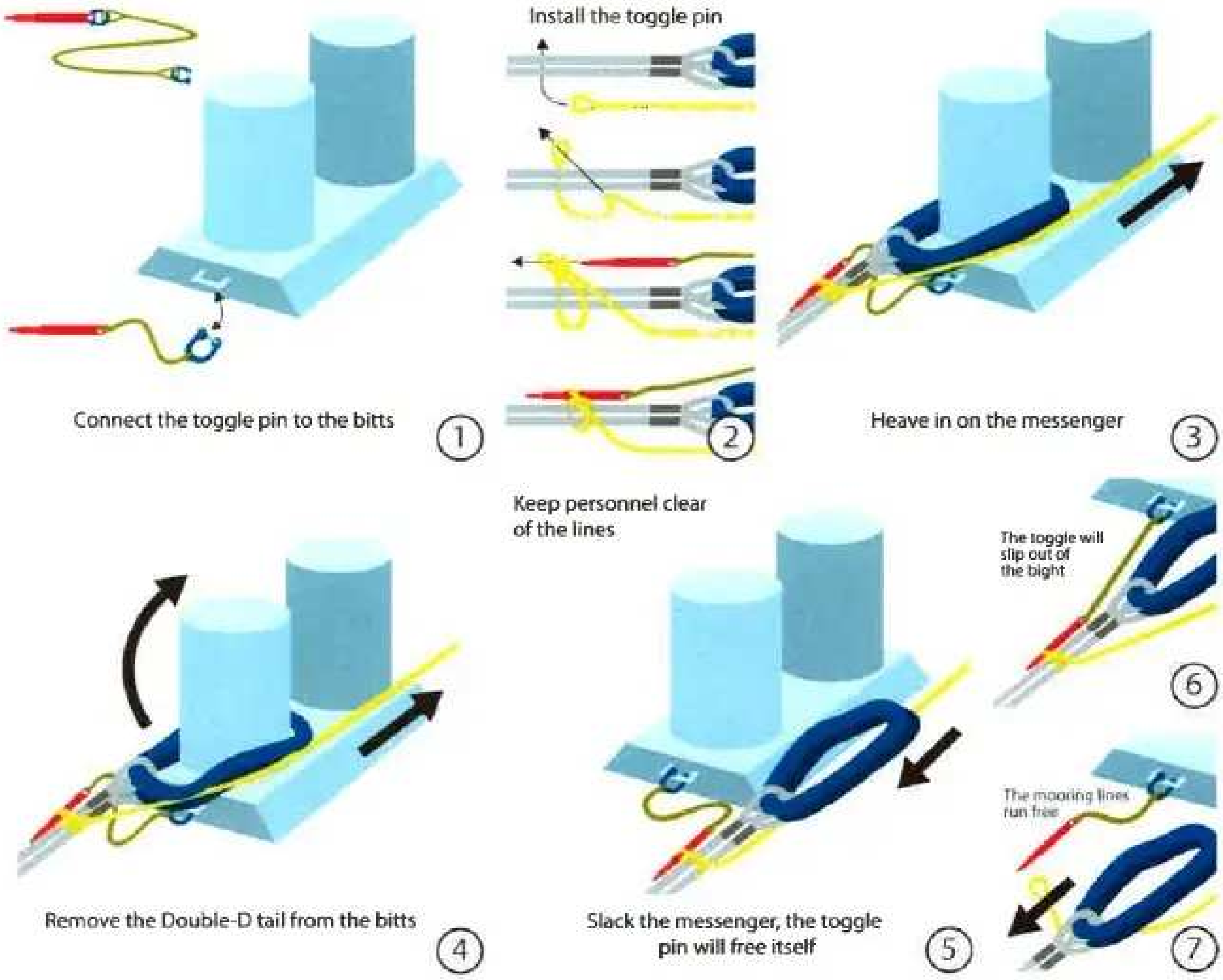
Install the toggle pin
Connect the toggle pin to the bitts
①
②
Heave in on the messenger
③
Keep personnel clear of the lines
The toggle will slip out of the bight
⑥
The mooring lines run free
Remove the Double-D tail from the bitts
④
Slack the messenger, the toggle pin will free itself
⑤
⑦

Figure 8.2: Unmooring with toggle pins with Double-D tails installed

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Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Equipment

Section 9

9.1 Fenders

9.1.1 Fenders used for at sea transfers

The fenders used in ship to ship (STS) transfer operations offshore are divided into two categories, primary and secondary fenders.

Primary fenders should be positioned with one at each end of the parallel mid-body, with the remaining fenders placed forward and aft of the manifold. Fenders should be kept clear of the manifold area.

Secondary fenders are used to protect bow and stern plating from inadvertent contact if the ships get out of alignment during mooring and unmooring. The point(s) where such contact is likely to occur is on the ship's side where the parallel body ends and the curve towards the bow and stern begins. The height above the waterline of the secondary fenders will be determined by the ship with the lower freeboard. The difference in freeboard between the two vessels should be determined prior to commencing the operation, and the secondary fenders positioned accordingly. A visual check should be made by the discharging ship, prior to final approach, and confirmation given that the secondary fenders are in the correct position for berthing.

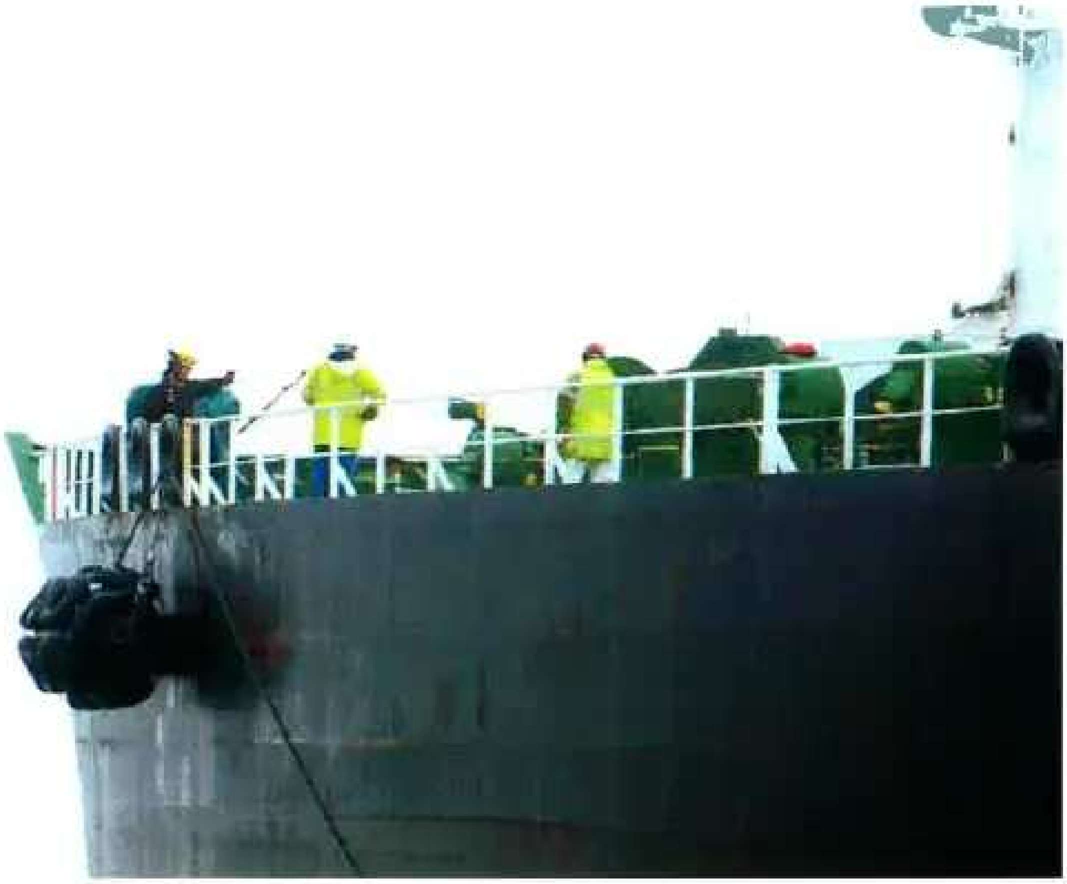

Figure 9.1: Secondary fender

Given the proximity of the primary fender towing line to the forward secondary fender, there is a risk of interference. Mitigation measures should be taken and personnel should be aware of the risk of the secondary fender suddenly boarding. The height of the secondary fender should be monitored and adjusted to prevent this interference.

There may be no suitable fairleads or securing points at the positions where secondary fenders are required. Portable chocks may be supplied by the STS service provider and these may be used in positioning the secondary fenders (see figure 9.2).

During the course of the transfer operation the height of the secondary fenders should be adjusted as required. It may be necessary to move the secondary fenders prior to unmooring if the likely point(s) of contact have changed due to changes in the freeboards of the two ships.

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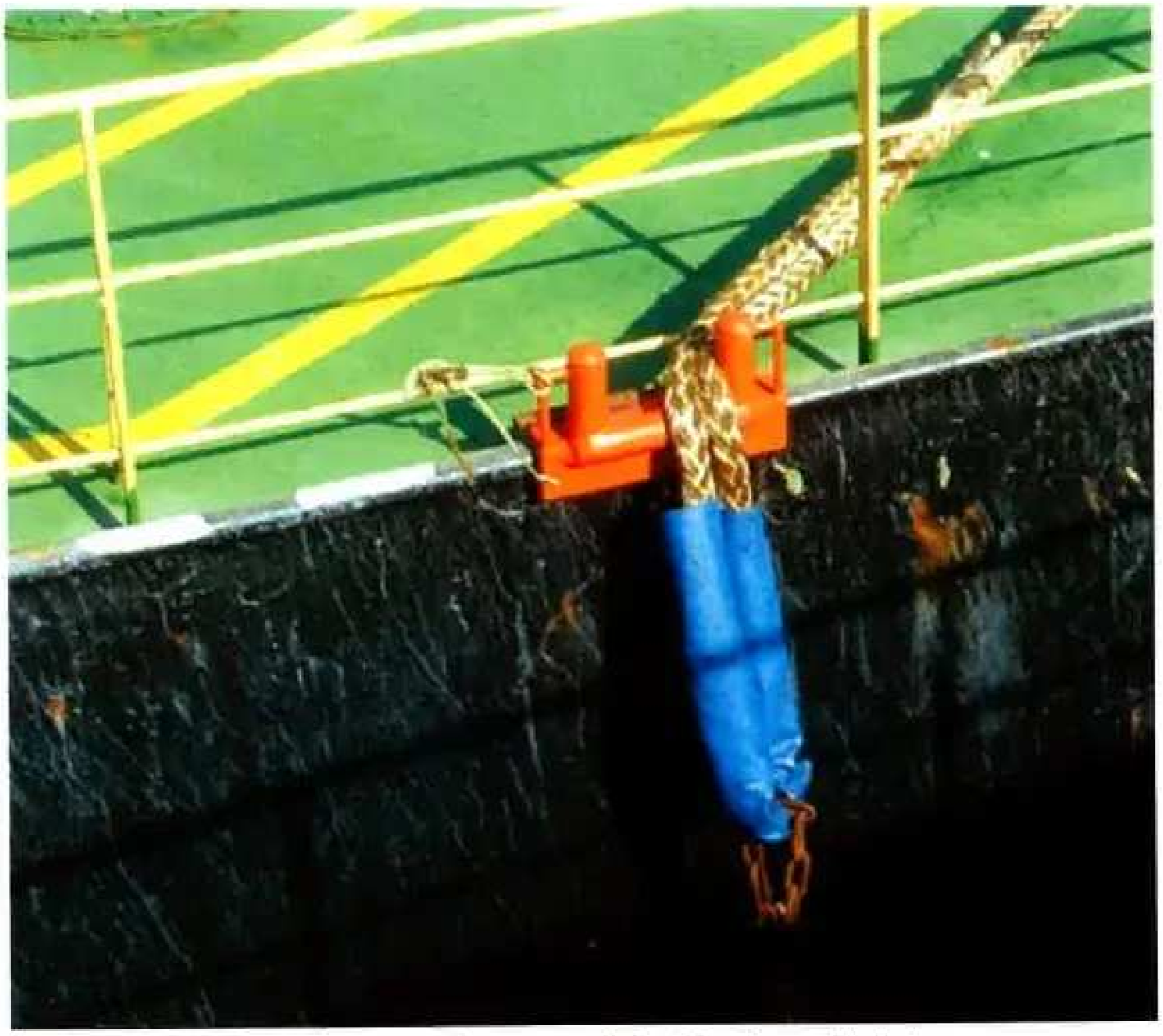

Figure 9.2: Secondary fender pennant deployed through a portable chock

It is recommended that primary fenders used are of the pneumatic type; manufactured, tested and maintained in accordance with International Organization for Standardisation (ISO) *Standard 17357* (reference 23) or other relevant ISO Standard.

ISO 17357 specifies the material, performance and dimensions of floating pneumatic fenders that are intended to be used for the berthing and mooring of a ship to another ship or berthing structure. It also specifies the test and inspection procedures for floating pneumatic fenders.

Secondary fenders may be of the pneumatic type or foam filled. If foam filled fenders are used, it should be noted that there are no comparable standards addressing their manufacture and testing. However, it is recommended that materials, verification and inspection for foam filled fenders are in accordance with a recognised standard, such as ISO 9000.

It is advantageous for secondary fenders to be light in weight because they must often be hauled well above the waterline and located in positions with limited access to lifting gear or support points. It may help if secondary fenders are capable of being moved quickly to counter possible inadvertent contact.

For operations where the STS transfer is carried out using a dedicated lightering ship, it is probable that

Except in cases where the STS transfer is carried out using a dedicated lightering ship, it is probable that fendering operations will be carried out with the assistance of an STS service provider. Such companies usually have support craft available and these vessels will normally assist in positioning fenders on the relevant ship.

Fenders may be placed on either ship after a review of the available mooring points and fairleads to accommodate the fender pennants. However, landing on an unprotected hull section is less likely if the fenders are rigged on the manoeuvring ship, and this is therefore the preferred option. It should be noted that where fenders are to be rigged on the manoeuvring ship there may be more stresses on the fender towing wire(s). In addition, being generally the smaller ship, a less effective lee for rigging is available.

In certain circumstances, such as a lightering operation involving several transfers to multiple vessels, it may be preferable to rig the primary fenders on the discharging ship. This option, which may result in less handling of the fenders, should be evaluated during the risk assessment for the operation.

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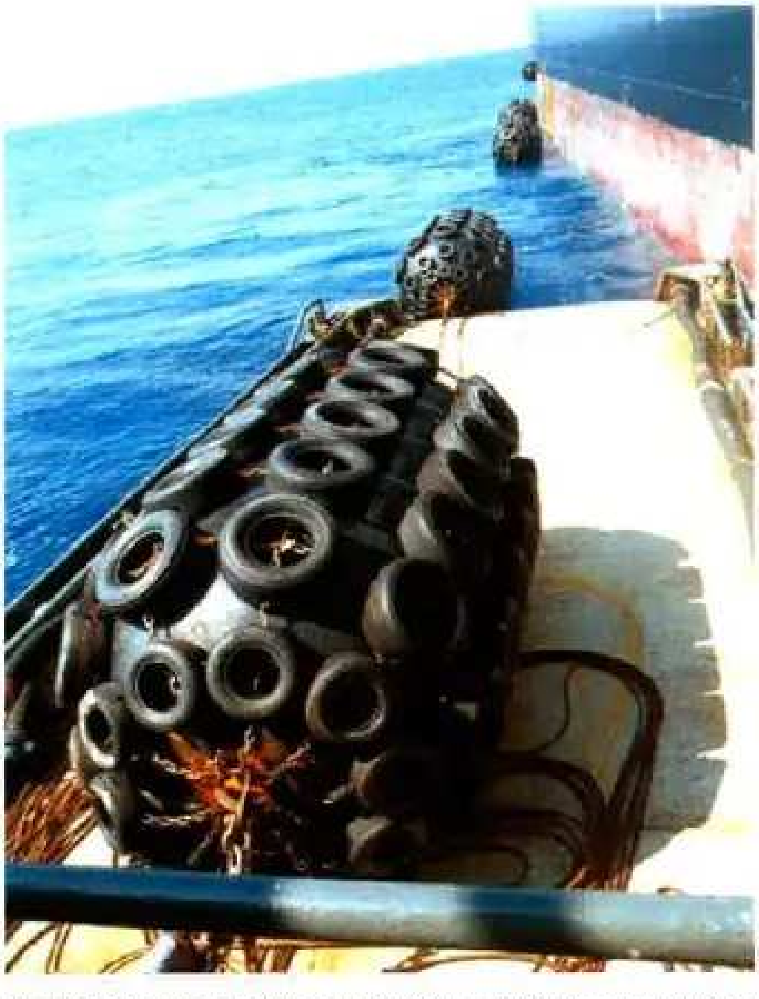

Figure 9.3: Fender string being deployed from a lightering support vessel

Whichever ship the fenders are rigged on, limits should be imposed on the vessel's speed to prevent over-stressing of the fender system.

As part of the vessel compatibility study, particular attention should be given to the parallel mid-body length of both vessels. This is of particular importance for operations involving fine-lined vessels such as gas carriers. As the parallel mid-body of larger liquefied natural gas (LNG) vessels tends to be much shorter than that of a conventional oil tanker of similar length overall (LOA), the correct placement of the fender string is critical to ensure adequate hull protection for both vessels. This may result in the need for the fender connection wires to be made to specific lengths for a particular operation.

The fender pennants may be secured to a winch mounted wire, if available, or made fast to a mooring bitt. If the fender pennant is shackled onto a winch mounted mooring wire, the winch brake should be correctly applied so as to avoid rendering that may result in the fender string moving out of position. When fender pennants are secured on a split drum mooring winch, the proper number of turns should be taken on the tension side of the winch to ensure effective brake holding power.

Bitts recessed in the shell plating should not be used for securing fenders due to access and safe working load (SWL) restrictions. Fenders should be kept clear of any recessed bitts (to prevent snagging) and from pilot doors located on either vessel's hull (where fitted).

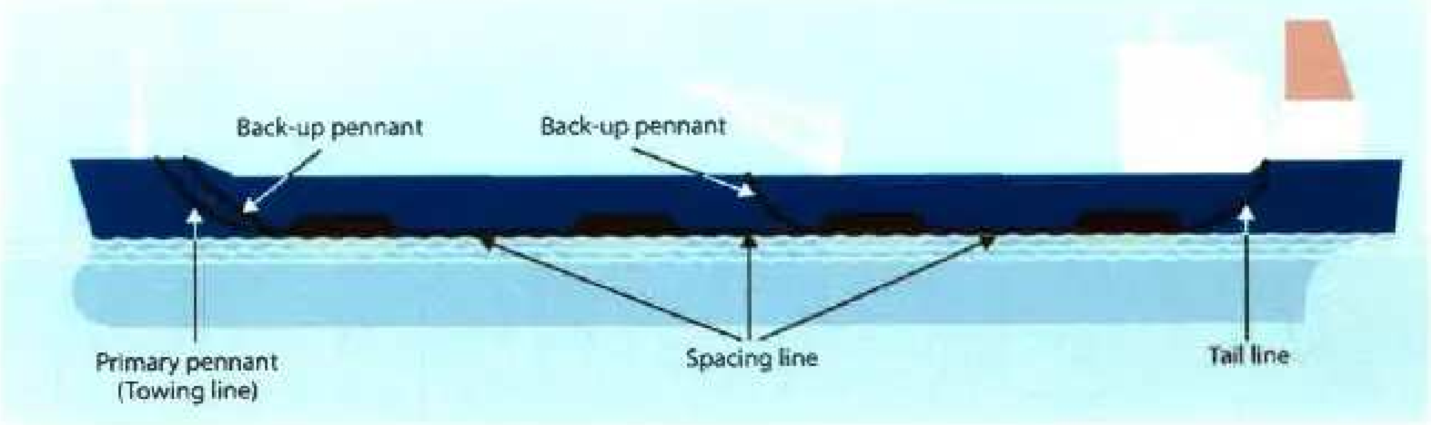

Figure 9.4: Typical arrangement of fenders rigged in a continuous string

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The STS Superintendent should have advised the position and method of securing the fenders to the ships in advance of the operation. Fender pennants should be led through fairleads in such a manner as to prevent chafing. Particular care should be taken to ensure that there are no obstructions, such as fish plates, which could chafe against the pennants. While rigged, the condition of the pennants should be regularly monitored.

When fenders are fitted to the manoeuvring ship, primary fenders should be positioned one at each end of the parallel body, with similar additional units fitted in between (see figure 9.4). The fender string may be made up to a prearranged length. Alternatively, in some operations where four fenders are used, it has been found beneficial to position them in two groups of two (see figure 9.5). In this way, and with each group positioned well forward or well aft on the parallel body, better protection can be provided. Fender pennants should be monitored frequently and tended as necessary to ensure that they do not become too slack or too taut and that the fenders remain in position.

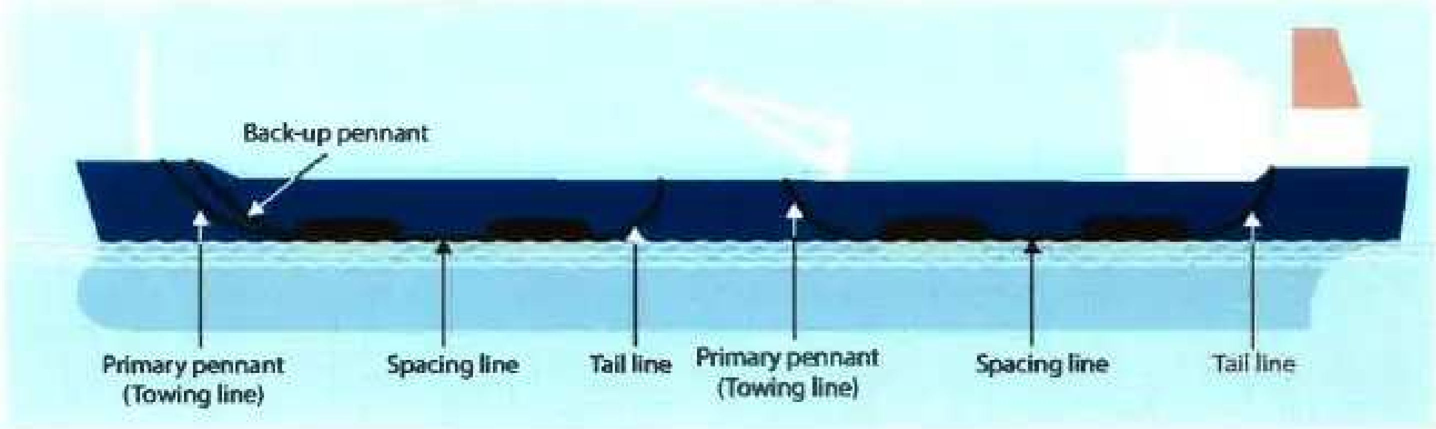

Figure 9.5: Typical arrangement of fenders rigged in pairs

The length of the fender string should be such that the fenders will be able to distribute the maximum anticipated impact load within the parallel body of both ships.

9.1.2 *Reference guide for fender selection for at sea transfers*

Table 9.1 provides a quick reference guide to fender selection and is only intended to be used to provide an indication of suitability under the conditions specified. It should be understood that different approach velocities would give very different energy absorption requirements. It should also be understood that the table is intended to be used with considerable discretion based on knowledge and experience of the type of operation to be carried out. This is particularly the case for values of 'C', which is the berthing coefficient, below 10,000 tonnes, where at least one of the ships involved is likely to have minimal freeboard and where different fender types may be necessary.

The table should be interpreted using the following formula:

$$C = \frac{2 \times \text{Displacement Ship A} \times \text{Displacement Ship B}}{\text{Displacement Ship A} + \text{Displacement Ship B}}$$

Table 9.1 gives approximate numbers and sizes for typical high pressure pneumatic fenders. Foam filled fenders may differ slightly in size and may vary in their energy absorption capacity due to the particular foam density used in manufacture.

Berthing energy, a factor of the combined displacement of the ships and the approach velocity, is one of the most important criteria for determining fender requirements. Typical berthing velocities are also given in table 9.1.

It should be noted that it is not always possible to judge approach speed accurately when berthing and that it may be prudent to err on the side of caution when selecting fenders. Manufacturers' recommendations for a calm weather situation and a maximum approach speed of, for example 0.15 m/sec. (0.3 knots) may be inadequate should weather be a factor and approach speed is significantly higher than planned, in which case selection of larger size fenders may be appropriate.

It is recommended that fender manufacturers or STS service providers are consulted prior to selecting the number and sizes of fenders for a particular operation. A sample form illustrating the information typically required when requesting assistance with fender selection is included in appendix H.

Appendix I provides additional guidance related to the selection of fenders for reverse lightering operations.

Berthing Coefficient (C) (Tonnes)	**Approach Velocity (m/Sec)**	**Berthing Energy (Tonnes.m)**	**Suggested Fenders (Quantity)**	**Typical HP Pneumatic Fender (50kPa) (Metre)**
1,000	0.30	002.4	3 or more	1.0 × 2.0
3,000	0.30	007.0	"	1.5 × 3.0
6,000	0.30	014.0	"	2.5 × 5.5
10,000	0.25	017.0	"	2.5 × 5.5
30,000	0.25	040.0	4 or more	3.3 × 6.5
50,000	0.20	048.0	"	3.3 × 6.5
100,000	0.15	054.0	"	3.3 × 6.5
150,000	0.15	071.0	5 or more	3.3 × 6.5
200,000	0.15	093.0	"	3.3 × 6.5
330,000	0.15	155.0	4 or more	4.5 × 9.0
500,000	0.15	231.0	"	4.5 × 9.0

Table 9.1: A quick reference guide to fender selection for standard ship to ship operations

9.1.3 *Fender requirements*

STS service providers, and some ship operators, will be able to call upon experience when assessing fender requirements for a particular STS transfer operation. It is advisable, however, to determine the forces that will be generated between berthing ships to provide information relevant to the selection process.

The fenders used should be suitable in terms of energy absorption and result in sufficient stand-off distance such that the compressed diameter of the fenders is always sufficient to ensure that there can be no contact between ships' structures through rolling during the period alongside. This is of particular importance when transfers are being made between vessels that have relatively high freeboards, such as gas carriers.

It is recommended that the fender diameter is less than half the freeboard of the ship to prevent inadvertent boarding of the ship by a fender during inclement weather.

To reduce abrasion damage to the outer rubber of the fender and to ensure that steel-to-steel contact does not occur between the fender cage and the ship's hull, fenders may be fitted with hard wearing tyres and cage components may be fitted with rubber sleeves.

Consideration should be given to fixing retro-reflective tape on the fenders to improve their visibility during hours of darkness.

Fenders should be subject to regular inspection for damage or deterioration. The pressure within pneumatic fenders should be regularly checked and the attached safety valves should be maintained in accordance with manufacturer's recommendations. A record of inspection and testing should be available.

The longevity of fenders will be determined by a number of factors including frequency of use, method of storage and standards of maintenance. As a guide, fenders should not be routinely used beyond the manufacturer's recommended service life, which will typically be 15 years. If fenders are provided by an STS service provider, the Master, shipping company or STS organiser should ascertain the age of the fenders to be used. It is recommended that all fender providers have detailed and accurate records regarding the history of the fenders. These records should include particulars of each job they were used for, inspection, testing, maintenance and casualty information.

When selecting fenders for specific operations, reference should be made to individual fender manufacturers' specifications and these should be addressed in terms of combined berthing displacement, approach velocity and sea and swell conditions. It is the responsibility of the STS organiser to determine the fender requirements and to agree these with all other parties involved.

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Fender selection is particularly important when planning to undertake reverse lightering operations (see appendix I) where consideration should be given to utilising fenders with higher energy absorption for the berthing phase than those recommended in table 9.1. In these situations the further guidance regarding approach velocity that is contained in appendix I should be taken into consideration.

9.1.4 *Fenders used for in port transfers*

It is important that ships engaged in STS operations within sheltered waters or in port are adequately fendered, taking into account approach velocity and energy absorption requirements in the prevailing conditions. Where possible, a risk assessment should be used to determine actual requirements and the guidance provided in section 9.1.2 should be referenced.

It is recognised that in certain trades in many regions of the world, fenders are provided in accordance with local customs and practices. Masters should reject any vessel should it be considered that the fendering arrangements are inadequate or pose the risk of metal-to-metal contact.

Figure 9.6: Foam fenders in use for an in port transfer

In chemical trades, with so many different sizes and configurations of vessels expected to moor alongside the mother ship, it may be difficult for the mother ship to provide adequate fendering that will suit all vessels. Typically, vessels mooring alongside the mother ship are responsible for providing fenders.

For larger vessels, the primary fenders may be either foam filled or pneumatic. Masters should have a clear understanding of the number and dimension of fenders required. For smaller vessels and barges, many different forms of fendering are utilised.

Primary fenders should be in place and secured prior to manoeuvring. Secondary fenders to protect the bow, stern and accommodation should be available for the crew to position as required to prevent contact of the vessels.

9.1.5 Low pressure fenders

Low pressure (LP) fenders are not routinely used for STS transfers at sea but, owing to their ease of transportation, they offer a viable option for specific STS operations, such as in the event of an emergency.

LP fenders can be manufactured to various sizes, with diameters up to 4.5 metres and lengths up to 30 metres.

Compared to high pressure (HP) fenders, which have an initial pressure of 50 or 80 kPa (500 or 800 mbar), an LP fender has an un-deformed pressure of 7 kPa (70 mbar), which rises to a maximum of around 100 kPa (1,000 mbar) when compressed. Typical energy absorption values for low pressure fenders are provided in table H2 in appendix H.

The following considerations relate to low pressure fenders:

- LP fenders may provide a soft cushion effect whereby energy can be absorbed across a large contact area, potentially minimising high localised loads. This can be a consideration when undertaking emergency STS operations to offload a damaged vessel.
- LP fenders that have equivalent energy absorption and stand-off characteristics to HP fenders are approximately half the weight of their HP counterpart, but significantly longer. Manufacturers should be consulted to obtain information on specific characteristics.
- The reduced weight and method of construction enables the LP fender to be rolled and folded for ease of transportation. Some typical package sizes for LP fenders are given in table 9.2.
- Compared to HP fenders, LP fenders are more susceptible to damage and abrasion.
- Due to their physical size when inflated, LP fenders may be difficult to handle on site.
- The inflation pressure of LP fenders needs to be carefully monitored, particularly with regard to the impact of changes to atmospheric pressure and ambient temperatures.

	Packed Size		
Fender Size (m)	**Length (m)**	**Width (m)**	**Height (m)**
1.0 x 4.0	1.6	0.8	0.5
1.8 x 8.0	2.0	0.7	0.7
2.3 x 12.0	2.0	1.2	1.0
2.8 x 14.0	3.0	1.4	1.4
3.3 x 16.0	2.7	1.6	1.5
4.5 x 22.0	4.0	1.6	1.4

Table 9.2: Typical package sizes for low pressure fenders

The International Organization for Standardization (ISO) is developing requirements for the construction, testing and maintenance of LP fenders, which are intended to be included in a revision to ISO 17357 (reference 23).

and maintenance of LP fenders, which are intended to be included in a revision to *ISO 17357* (reference 23).

9.1.6 *Ribbed fenders*

Ribbed fenders are available that have similar dimensions, pressure ratings and energy absorption characteristics to HP fenders. Ribbed fenders are generally not recommended for use as primary fenders in exposed locations.

Ribbed fenders have an arrangement of wear resistant ribs instead of a protective cage, which makes them lighter than an equivalent sized HP fender. The ribs do not provide a similar degree of protection to the fender body as a properly constructed and fitted tyre cage.

While ribbed fenders may be manufactured and use materials in accordance with the requirements of *ISO 17357* (reference 23), the provision of ribs means they are not compliant with the standard, which only addresses smooth fender surfaces.

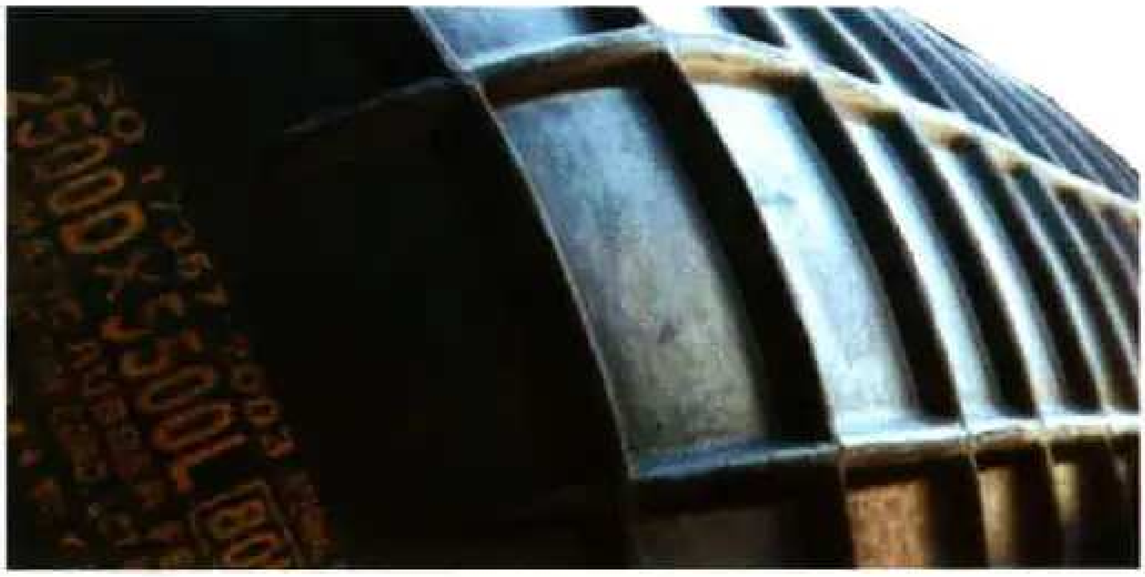

Figure 9.7: Ribbed fender

9.1.7 *Foam filled fenders*

Foam filled fenders are not commonly used as primary fenders in exposed locations. They may be suitable for use as primary fenders for operations conducted in port or within sheltered waters.

Foam filled fenders have a closed-cell foam core that is covered by a flexible protective skin. The foam core results in the fender retaining buoyancy should the outer cover be damaged.

Foam filled fenders may be provided with a protective cage.

Typical energy absorption values for foam filled fenders are provided in table H1 in appendix H.

9.2 Cargo transfer hoses

9.2.1 *Hose standards*

Hoses used in STS operations should be specially designed and constructed for the product being handled and the purpose for which they are being used. They should be checked at time of issue as being suitable for the intended use.

There is no international standard that specifically addresses hoses used in STS operations, and existing dock hose standards have often been used when assessing the suitability of hoses for such service. These standards include *EN1765* for oil service (reference 26), *EN13765* for oils, solvents and chemicals (reference 31), *ISO 10380*, *ISO 2928* and *EN 13766* for liquefied petroleum gas (LPG) (references 24, 25 and 27), *EN1474-2* for LNG (reference 28), and *EN ISO 8330* and *EN ISO 8031* for rubber and plastics hoses and hose assemblies (references 38 and 39).

Hoses are in use for some STS operations that do not presently conform to an international standard. Although they have given incident free service over many years, and aspects such as their ease of handling and kink tolerance have proven operationally advantageous, no independent technical justification currently exists to support their use. These hoses, commonly referred to as semi-continuous hoses should be subjected to independent evaluation supported with an appropriate hazard review to ensure they are safe for the specific operation until an appropriate international standard is established.

The recommended electrical property of the hoses used, continuous or discontinuous, will depend on whether or not an insulation flange is installed at the manifold of one of the ships (see section 3.10.4). If an insulation flange is in place, the hose string should comprise of electrically continuous hoses. If an insulation flange is not used, a single length of electrically discontinuous hose should be installed within the string.

A visual inspection of each of the hose assemblies should be carried out, before they are connected to the manifolds, to determine if any damage has been caused through handling. If damage to a hose (or flange) considered to be critical to the operation is found, the hose should be withdrawn from service.

Appendix C9.2 provides additional guidance on hoses used for LPG transfer and appendix D9.2 provides information on hoses and transfer systems used for LNG.

9.2.2 *Hose length*

Hose lengths should be considered on a case by case basis, taking into account any special characteristics of the ships or features of the operation.

In determining the length of hoses to be used, matters to be considered may include the following:

- Minimum allowable bend radius of the hose (see 9.2.4).
- Horizontal distance between the vessels.
- Difference in fore and aft alignment (manifold offset).
- Distance between manifold and ship's side.
- Vertical and horizontal vessel movement.
- Any other special characteristics related to the vessels.
- Relative change in manifold heights between the vessels.
- Minimisation of number of hoses used in the hose string.
- Hose handling requirements and any limitations of the ship's equipment.

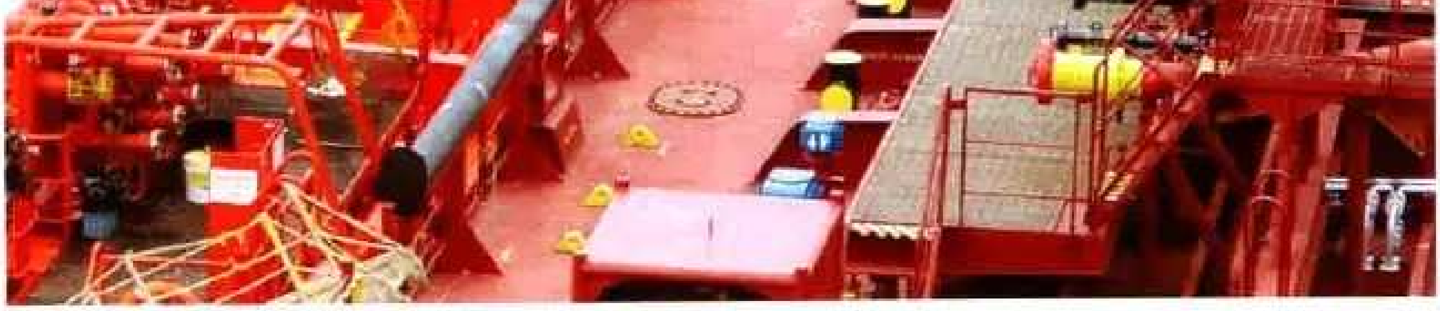

Figure 9.8: Hose rigged for chemical transfer

9.2.3 *Pressure ratings and flow velocities*

Hoses should have pressure ratings that are appropriate for their intended service.

The maximum permissible flow velocity through a hose is limited by its construction. The hose manufacturer's recommendations and certification should give details of recommended flow rates/velocities, and these should not be exceeded.

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Flow rates for different hose velocity ranges can be calculated using the following formula:

$$(\pi r^2 v \times 3{,}600 = \text{cubic metres per hour})$$

Where 'r' is the internal radius in metres and 'v' is flow velocity in metres per second.

Irrespective of the designed maximum flow velocity of the hose, consideration should be given to any flow restrictions posed by other equipment, such as valve linings.

Reference should be made to appendix C9.2 for information on maximum flow velocities for LPG transfers.

9.2.4 *Hose handling*

Care should be taken when handling and supporting hose strings to avoid any kinking or over-stressing that may cause damage or reduce service life.

To prevent damage when handling or supporting hoses, due account should be taken of the hose's minimum bending radius (MBR). For guidance, a rule of thumb for calculating the MBR of a rubber hose is given by the formula:

$$\text{MBR} = \text{Nominal Bore of Hose} \times 6$$

As an example, a 300 mm (12 inch) hose will have a minimum bending radius of approximately 1.8 metres (72 inches).

Hoses in excess of 300 mm in diameter will be progressively more difficult to handle and particular care will be needed to avoid damage from kinking unless the hose assembly is specifically designed to overcome this problem.

The maximum hose size may be governed by the capabilities of the on board lifting equipment and manifold construction.

When using hose strings comprising of more than one length of hose, the tightness of connecting flange bolts should be checked before each transfer operation, if practical (see appendix J).

The cargo transfer equipment should be supported by suitable means to prevent excessive loads on manifold fittings in accordance with manifold guidelines published by OCIMF and SIGTTO (references 17 and 18).

Suitable hose supports should be employed to ensure the hose bending radius is maintained within manufacturer's guidelines and to assist in supporting the hose throughout the transfer operation. These supports may form an essential part of the load restraint system, preventing excessive axial and torsional loads on the cargo hose end fittings. Their design load and security should be considered along with their ability to prevent chafing of the hose(s) and their ability to avoid damage to handrails and other fittings in the event of a separation of an emergency release coupling (ERC), where fitted. Their design should ensure electrical isolation is maintained between the hose and the ship's structure.

9.2.5 *Hose connection*

Flanges and quick connect/disconnect (QC/DC) couplings should be in good condition and properly secured to ensure leak-tight connections. The gaskets used at the ship's manifolds and between each hose should be made from a material suitable for use with the cargo to be transferred.

Both ships will be expected to provide the necessary personnel to connect the hoses. As this is an operation not frequently carried out by ships' crews, it should be properly supervised and the integrity of the connection confirmed.

Guidance on the connection of hoses for STS operations is provided in appendix J.

Prior to commencing transfer of certain products, such as many of those associated with the chemical and gas trades, the integrity of hose assemblies should be verified by a pressure test. Pressure testing of hose assemblies may also be required by local authorities.

QC/DC couplings may be used to connect transfer hoses to the ship's manifold. The coupling provides a quick and effective method of making the connection. The two flanges to be joined are brought together and are positioned within the cam blocks around the coupling. Using a short length of bar, the cams are then rotated to secure the coupling. An internal 'O' ring provides a seal within the coupling. The time taken to set and lock each cam is typically less than five seconds.

Manufacturer's guidance on operating and maintenance procedures should be followed.

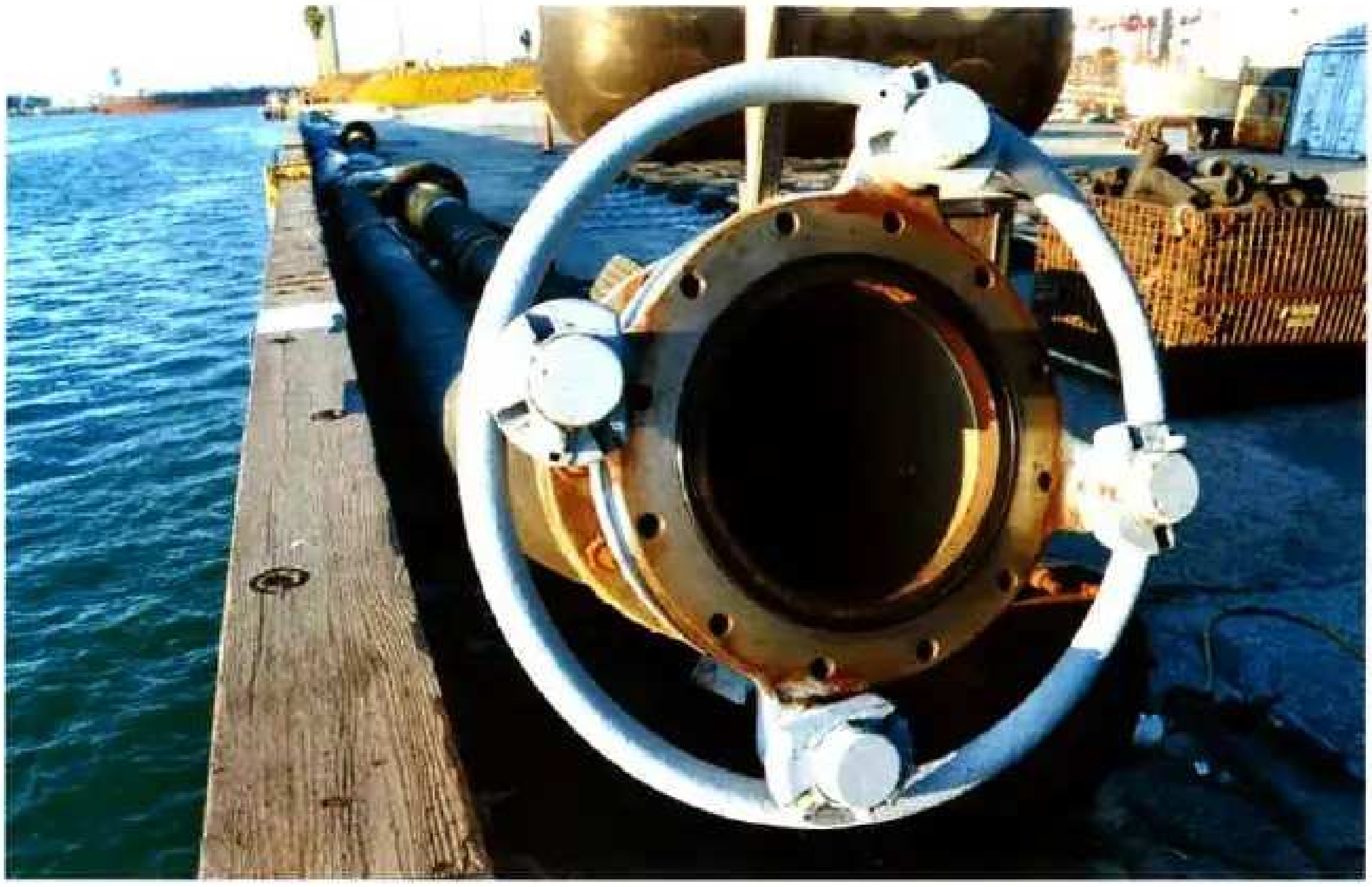

Figure 9.9: Manually activated quick connect/disconnect coupling

9.2.6 *Hose inspection and testing*

Hoses should be visually inspected prior to use.

If hoses are supplied by an STS service provider, confirmation that they are fit for the intended service and valid test certificates should be provided.

Hoses used should be subject to regular inspection for damage or deterioration. A record of inspection and testing should be available. Testing of hoses should be in accordance with the requirements of the standard to which the hose was manufactured, local regulatory requirements and manufacturer's recommendations. Periodic tests, undertaken at intervals not exceeding 12 months, may include hydrostatic pressure tests, including an assessment of temporary and permanent elongation, and electrical continuity tests.

In consultation with the hose manufacturer, the retirement criteria for the hoses should be defined to determine when they should be removed from service.

9.2.7 *Marking*

Each transfer hose should be permanently marked with the information required by the appropriate international standard and other applicable regulations, such as the *IGC Code* (reference 10). Information provided will include details such as:

- The manufacturer's name or trademark.
- Identification of the standard specification for manufacture.
- Maximum allowable working pressure.
- Month and year of manufacture and manufacturer's serial number.
- Indication that the hose is electrically continuous, electrically discontinuous or semi-continuous.
- The type of service for which it is intended e.g. oil, product, petroleum gas.

[illegible]

9.3 Mooring equipment

It is important that ships involved in STS operations are equipped with good quality mooring lines, efficient winches, well placed and sufficiently strong closed fairleads, bollards and other associated mooring equipment. The correct functioning of winch brakes should be ensured through regular testing. It is recommended that fairleads and bollards are sized, marked and certified in accordance with the guidance provided in *Mooring Equipment Guidelines* (reference 6)

Only fairleads of the enclosed type should be used to ensure effective control of mooring lines as the freeboards of the two ships changes. Fairleads should be large enough to allow the mooring line (plus any soft rope tail and shackle) to pass through comfortably. Open fairleads, even those fitted with stopper bars, are not recommended for STS operations.

A ship's standard complement of mooring lines is generally suitable for STS transfer operations, but ships equipped with steel wire or high modulus synthetic fibre mooring lines should fit soft rope tails to provide elasticity and permit cutting away in the event of emergency. For this reason a sharp axe should be available at all mooring stations.

Rope tails should be at least 11 metres long and have a dry breaking strength at least 25% greater, or 37% greater if polyamide (nylon), than that of the lines to which they are attached. The connection between a wire rope and the soft rope tail should be made with an approved fitting e.g. Mandal, Tonsberg or Boss shackle. With high modulus synthetic fibre ropes, the tail can normally be attached using a cow hitch, but manufacturers' recommendations should be checked to ensure requirements for minimum radius bends are observed.

Vessels frequently involved in lightering may be equipped with special mooring line arrangements such that the synthetic fibre tail is of a different length to that recommended in *Mooring Equipment Guidelines (MEG)* (reference 6) and may, additionally, be fitted with wire pennants such that the synthetic part is wholly outside the fairleads to reduce chafing. However, it is recommended that wire pennants are not passed through fairleads that are normally used for synthetic (e.g. high modulus) ropes as they will cause grooving of the surface, which will subsequently damage the synthetic rope. Where this is not possible, additional protection may be required to prevent grooving or abrasion damage to the surface of the fairlead.

Heaving lines and strong rope messengers should be available at the mooring stations on both ships.

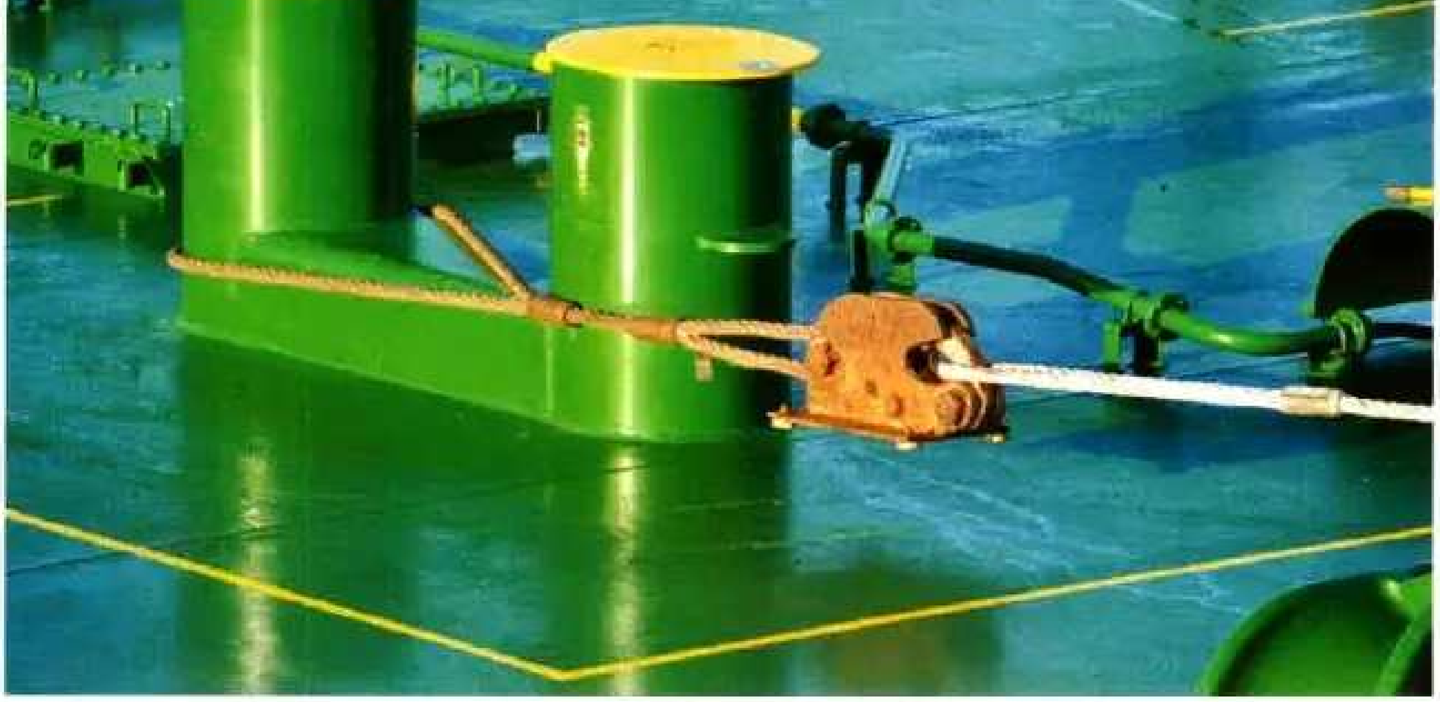

Figure 9.10: Wire tail connected to a portable quick release hook

In practice, it has been found that the smaller ship's standard mooring equipment is generally suitable for STS transfers. Larger ships may require additional fittings to allow a proper mooring pattern. When tankers over 160,000 dwt, or other vessels with similar dimensions, are used for STS operations it is recommended that they are fitted with full sized bitts and closed fairleads as close as is practical to the forward and aft ends of the manifold, to take the spring lines from the smaller ship (see *Mooring Equipment Guidelines* - reference 6). To prevent chafing of lines, it is recommended that the larger ship does not utilise any fairleads located on a transom stern.

The recommended minimum number of closed fairleads on the larger ship for STS operations is three aft and four forward. Typically, a mooring pattern for exposed locations for lightering vessels not fitted with special mooring arrangements would consist of at least six head lines, two forward and two back springs, and four stern lines. Where specialised mooring equipment is fitted (e.g. on dedicated STS transfer ships) the number of head lines could be reduced to four where this has proven to be reliable for the local operating environment.

The aft closed fairleads should be located as far aft as is practical and the forward closed fairleads should be located as close as is practical to the centre line and clear of any protruding anchor housings. In determining the location of closed fairleads, consideration should be given to achieving a mooring arrangement that allows mooring lines of the same function (head lines, stern lines, breast lines or springs) to run as parallel as possible to each other in order to most effectively share the mooring load. It is desirable that each designated STS suitable closed fairlead on the larger ship be accompanied by bitts capable of taking at least two mooring lines and rated to at least the same safe working load (SWL) as the fairlead. Each set of bitts should be sited or arranged for safe use of messengers and attendant winches.

In addition, it is recommended that provision is made for securing fender lines.

9.4 Personnel transfers – at sea operations

In general, it is recommended that the transfer of personnel between ships be kept to an absolute minimum. If the transfer of personnel is unavoidable, the safest means of transfer should be verified by risk assessment. This assessment should consider the prevailing circumstances and conditions at the time and place in question and should compare the risks associated with any alternative means of transfer that may be available.

The following recommendations should be considered:

- Gangways should only be used in sheltered locations where there is little or no vessel movement. If used, gangways should be of a lightweight insulated type fitted with rails and complete with a safety net and should be tended to ensure they remain at all times within safe design operating parameters. Open rung ladders should not be used.

- Where workboat transfers take place using appropriate pilot ladder/accommodation ladder combinations, due account should be taken of the freeboard. Consideration should always be given to the sea conditions, the suitability of the workboat and the experience and fitness of transferring personnel. The pilot ladder/ accommodation ladder combination should be rigged in accordance with the *Shipping Industry Guidance on Pilot Transfer Arrangements* (reference 32).
- Prior to commencing personnel transfer using a personnel transfer basket (PTB), it should be ensured that the PTB is suitable for the task, certified, tested and inspected, the associated lifting equipment is suitable for personnel transfer and that adequate procedures are in place. An example checklist for use in the planning and execution of personnel transfers by basket is included as appendix F.

The following factors, although not exhaustive, should be among those taken into consideration before making the final selection of transfer option and commencement of transfer operations:

- Account should be taken of the presence of any national or local regulations, or relevant codes of safe working practice, that govern transfers of personnel in open waters using the method under consideration.
- All personnel involved in the transfer operation should be appropriately trained and familiar with the contents of the risk assessment.
- All transferring personnel should wear full safety and personal flotation devices (PFD).
- Crew members operating any lifting equipment or working in the vicinity of the transfer area should wear the appropriate personal protective equipment (PPE).
- The Master or a senior deck officer should supervise the transfer operation.

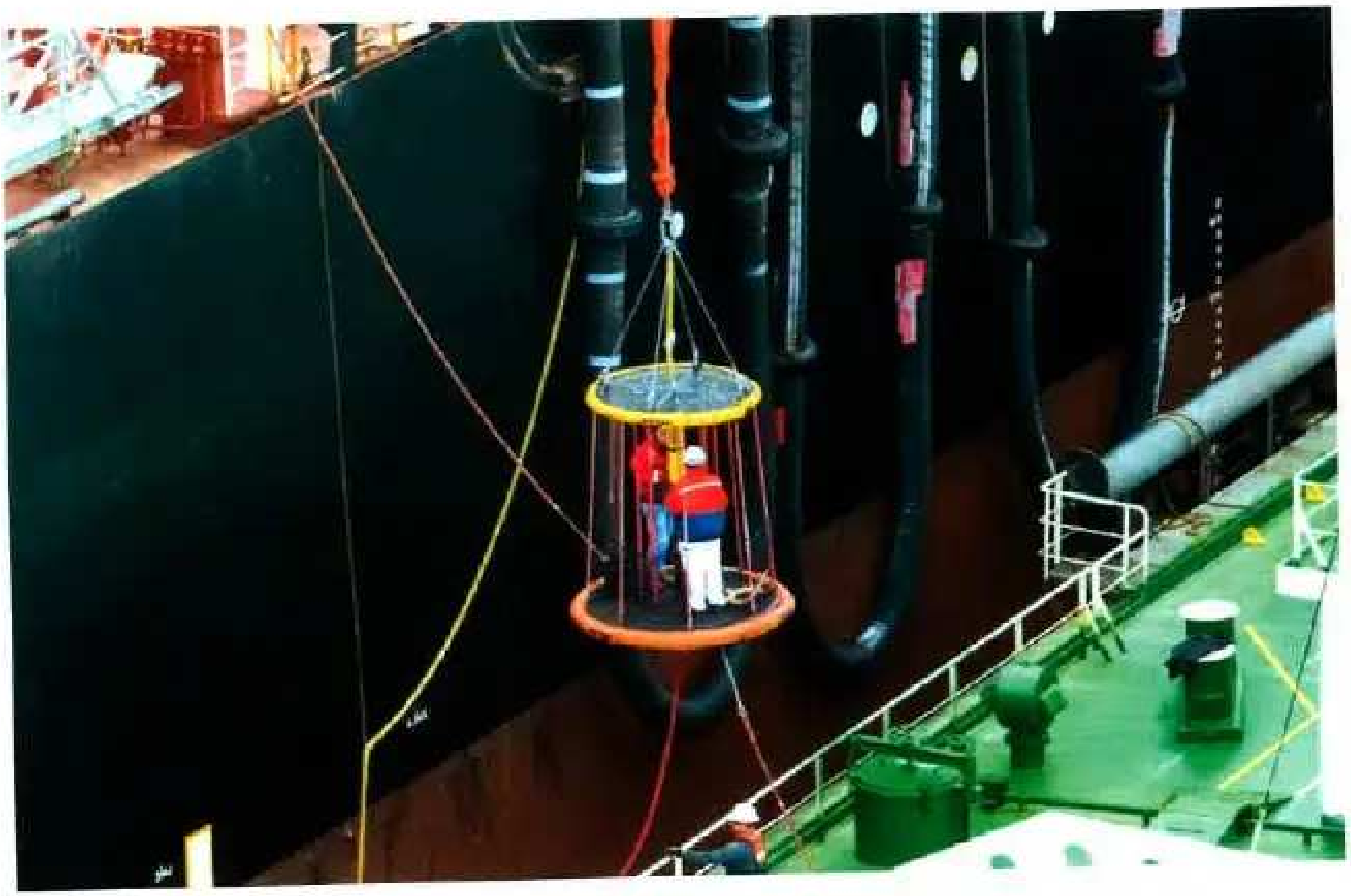

Figure 9.11: Transferring personnel

9.4.1 *Suitability of lifting equipment*

The following factors should be taken into account when considering the suitability of a vessel's lifting equipment and PTBs:

- Derricks should not be used.
- Any crane utilised should be equipped with adequate safety devices to prevent free fall. Hoisting and lowering limiters are preferred and their availability (or otherwise) on the equipment intended for use should be addressed in the risk assessment. Means should be provided to safely recover persons being transferred in the event of power or control system failure.

- All lifting equipment should be inspected, maintained, load tested and certified as required. This includes PTBs, rigging and strops. Lifting equipment should be included in, and maintained in accordance with, the ship's planned maintenance schedule. All load certifications or class documents should be available for inspection.
- The maximum permitted load of lifting equipment when being used for personnel transfer should be identified and should include an additional safety factor.
- PTBs should be specifically designed for the intended purpose and maintained in a suitable condition.
- All hooks or shackles should be properly closed and moused or wired.
- The lifting equipment should be able to reach the safe landing area while maintaining a vertical lift. In assessing this the diameter of the fenders needs to be taken into account, together with the potential freeboard difference. Any limitations associated with the crane boom's minimum or maximum angles should also be considered.
- Communications should be provided by the most effective method between the signalman, the equipment controller (crane operator) and the personnel in the basket. Methods to be employed should undergo thorough evaluation prior to operations commencing. All scenarios should be assessed and should include the following considerations:
  - Personnel using the basket may have restricted mobility and visibility and this may restrict their ability to use hand signals or operate radio equipment.
  - Signalmen are required to keep the basket and equipment controller in full view at all times to maintain effective control of the operation.

  - Operating areas should comply with appropriate noise level codes (see section 9.8). However, high background noise levels and ambient conditions (e.g. hydraulic machinery, wind etc) should be anticipated and may present difficulties with audio communications.
- Personnel using the transfer basket should be instructed in the proper procedures for its use.
- Operators should be trained before using the equipment for personnel transfer. This should not be limited to classroom training, but should also include simulated dummy loads being transferred under practice until the operation can be completed with minimal risk.
- Prior to commencing the first transfer of personnel, a simulated transfer should be undertaken.
- When making personnel transfer lifts, the load must be under full control (both in raise and lower modes) and the transfer basket should only be raised high enough off the deck to clear all obstructions and minimise swinging.
- Sufficient trained personnel should be available to provide assistance.

Contingencies should be developed for any foreseeable emergency that may occur during the personnel transfer operation.

When developing the specifications for new vessels, it is recommended that consideration is given to the need for the ship to be provided with lifting equipment that is certified for man-riding.

9.5 Personnel transfers – in port operations

For STS operations conducted at anchor in sheltered waters or alongside in port, there will be varying needs to establish a safe means of access between involved vessels. For example, during double banked transfers, personnel on the outer vessel(s) may need to traverse the vessel alongside to access the terminal.

In all cases, a formal risk assessment should be utilised to identify the safest means of personnel transfer between the vessels. If safe access can be established by means of a gangway, a safety net should be rigged. Otherwise, access may be via a pilot ladder rigged from the vessel with the higher freeboard directly to the deck of the vessel with the lower freeboard. Where there is a disparity in deck levels, or the distance between the vessels is too great to maintain safe access between them, it may be necessary to employ a launch to ferry personnel between two safe access points.

Only personnel wearing a personal flotation device should be permitted to move between the two vessels and their transit should be supervised by a responsible officer. A lifebuoy should be ready for use at the transfer point. Wharf ladders should be used with caution.

9.6 Lighting

During STS transfers at night, normal in-port deck lighting should be adequate. It should be ensured that manifold areas, work areas and personnel access points are adequately lit. The lighting should not interfere with the keeping of an effective lookout or impair the recognition of the ships' navigation lights and signals. It should also be understood that deck lighting may need to be extinguished (and STS operations shut down) if a close-quarters situation develops.

Portable spotlights, which should be suitable for use in hazardous areas, and bridge wing searchlights are useful for night mooring and unmooring operations.

9.7 Ancillary equipment for ship to ship operations

All equipment relating to the handling, securing and/or support of cargo transfer hoses, primary and secondary fenders and STS support craft should be inspected prior to commencement of the STS operation. Retirement criteria should be established.

9.8 Equipment noise levels

Excess noise levels in the vicinity of equipment can influence the safety of operational communications and affect off duty personnel during rest periods, contributing to fatigue. It is recommended that noise levels are assessed and that appropriate measures are taken to minimise disruption. This may include the need to designate alternative sleeping arrangements for any affected crew members.

Ship to Ship Transfer Guide for Petroleum, Chemicals and Liquefied Gases

Emergencies

Section 10

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10.1 Contingency planning and emergency response procedures

Ship to ship (STS) transfer operations may be carried out safely through adherence to proper procedures and the use of suitable equipment. However, the risk of accident and the potential scale of the consequences require that organisers and vessel operators develop contingency plans for dealing with emergencies. Ship-specific contingency plans covering the possible range of emergency scenarios should be considered as part of the ship's safety management system (SMS) and, where appropriate, its STS Plan.

For STS operations, a risk assessment should be carried out as described in section 3.2.2. The risk assessments should be used to identify and document any potential emergency scenarios that are not already covered by the ships' emergency response plans. Risk mitigation and contingency plans should be drawn up to cover all possible emergencies and provide for a comprehensive response. In addition, contingency plans should have relevance to the location of the operation and take into account the resources available, both at the transfer area and with regard to nearby back-up support. Where appropriate, the contingency plan should be integrated with similar plans prepared by the responsible local authority. In some locations, approval of the plans may be required by the local authority.

Consideration should be given to:

- Procedures for raising the alarm.
- Cessation of operations during emergencies.
- Notification procedures.
- Emergency stations and preparations to initiate emergency procedures.
- Deployment of mooring gangs to stations.
- Emergency disconnection of cargo transfer equipment.
- Preparation of engines for manoeuvring.
- Unmooring.

The joint plan of operation (JPO), agreed by all involved vessels, should include the contingency plans for the operation. The information should include an emergency contact list that should be posted on board all vessels. Emergency procedures should cover the full scope of the operation and include, for example, scenarios such as:

- Vessel collision during mooring/unmooring manoeuvres.
- Cargo spill.
- Toxic or flammable vapour release.
- Fire/explosion.
- Multiple mooring line failure.
- Emergency unmooring.
- Emergency on own vessel or other vessel involved in operation.

In an emergency, both Masters should assess the situation and act accordingly and, if applicable, in consultation with the STS Superintendent. When considering emergency response options, reference should be made to the information provided in the material safety data sheets (MSDS) of the products being handled.

Coastal States or other authorities may impose specific contingency and notification requirements.

Emergency duties should be assigned to personnel. An appropriate drill should be held, where practicable, within 24-hours and in any case not more than 7 days before commencing STS transfer operations. Ships' crews should be made aware of emergency signals, procedures and actions.

For vessels carrying Annex I cargoes, reference should also be made to appendix A10.

Reference should be made to Appendices C10.1 and D10.1 for additional information on emergency systems and procedures associated with liquefied petroleum gas (LPG) and liquefied natural gas (LNG) transfers.

10.2 Emergency signal

An emergency on either ship should be indicated immediately by sounding the ship's internal alarm signal and by sounding five or more short blasts on the ship's whistle to warn the other ship. The emergency signal should be communicated to all personnel on both vessels and understanding confirmed. All personnel should then proceed as indicated by the contingency plan. It is emphasised that both ships should be in an advanced state of readiness at all times in order to be in a position to deal with emergencies.

10.3 Emergency situations

It is difficult to anticipate every emergency that could arise. However, the scenarios described below should be among those that organisers include in the contingency plan.

In an emergency, the Masters involved should assess the situation and act accordingly. Masters should decide jointly, particularly in cases of fire, whether it is to their mutual advantage for the ships to remain alongside each other.

10.4 Examples of potential emergencies

Vessels involved in an STS operation should have procedures ready for immediate implementation in the event of an emergency. Personnel involved should be familiar with the procedures and should clearly understand the action they would be required to take when responding to the emergency. STS service providers should have anticipated and fully considered the implication of all types of emergency that might be encountered during an STS operation.

10.4.1 *Emergencies during manoeuvring*

The Masters of both ships and the STS Superintendent should always be prepared to abort a berthing operation if necessary. The decision should be taken in ample time and while the situation is still under control. The Masters of both ships should be immediately informed of each other's actions.

10.4.2 *Procedures in the event of gas accumulation on deck*

The atmosphere around the discharging ship and decks of other vessels moored alongside should be monitored for both flammable gas and toxic vapour. This is particularly relevant where vessels of different sizes and configurations are engaged in transfer operations. Immediately on detecting potentially excessive or hazardous levels of flammable gas or toxic vapour, transfer operations should cease. The atmosphere should continue to be monitored and transfer operations only resumed when it is safe to do so.

10.4.3 *Accidental cargo release*

Leakages or spillages should be reported to the officers on cargo watch, who should immediately stop the cargo transfer. The transfer should remain suspended until it is agreed between the relevant persons/ authorities that it is safe to resume.

For liquid chemical transfers, response teams should not be deployed until the product released has been identified and all vessels have been advised of the dangers presented. Responders should be made fully aware of the chemical properties of the released product and should use the correct personal protective equipment (PPE) and breathing apparatus required.

For in port transfers, the harbour master should be informed in order to restrict passing traffic and notify local facilities and populations of the potential danger.

10.5 Shipboard Oil Pollution Emergency Plan (SOPEP), Shipboard Marine Pollution Emergency Plan (SMPEP) and Vessel Response Plan (VRP)

Risk of pollution from the cargo during STS transfer operations is no greater than during conventional transfers. However, as a transfer area may be out of range of port services, a contingency plan within the Shipboard Oil Pollution Emergency Plan (SOPEP), Shipboard Marine Pollution Emergency Plan (SMPEP) or Vessel Response Plan (VRP), as appropriate, to cover such risk should be available and should be activated in the case of an oil spill.

10.6 State of readiness for an emergency

The following arrangements are among those that should be made on both ships:

- Main engines either in standby mode or on short notice of readiness.
- Cargo pump and all other equipment trips relevant to the transfer tested prior to the operation.
- Crew available and systems prepared to drain and disconnect hoses at short notice.
- Spill management equipment prepared and ready for use.
- Mooring equipment ready for immediate use and extra mooring lines ready at mooring stations as replacements in case of breakage.
- Fire-fighting equipment ready for immediate use.

10.7 Cessation of transfer operations as a precautionary measure

All transfer operations should cease should an unsafe or environmentally hazardous condition develop. Such conditions may include but are not limited to:

- Failure of hoses, moorings or fender pennants.
- Deterioration of weather and/or sea conditions, including lightning.
- A dangerous concentration of gas.
- Loss of containment.
- Loss of power (black-out) on either vessel.
- Close-quarters situation with another vessel or navigational hazard.
- Any emergency on the other vessels involved in the operation.

Appendices

A-L

Appendix A: Additional considerations for ship to ship transfers involving *MARPOL* Annex I cargoes (crude oil and petroleum products)

Note: The paragraph numbering used reflects the relevant section within the main body of the document to which the additional guidance in the appendix relates.

Compliance with the provisions of MARPOL Annex I

Chapter 8 of *MARPOL* Annex I contains requirements relating to the at sea transfer of oil cargoes between tankers. The amendments to MARPOL, which entered into force on 1st January 2011, are contained in new Regulations 40 to 42 which, in turn, address applicability, requirements for STS Operations Plans and notification requirements. Further guidance is available in the *Manual on Oil Pollution*, chapter 6, section 1 *Prevention* (reference 12).

A1.5 Control of operations

Ship to ship operations plan

Administration approved STS operations plans shall be carried on board and copies should be available in the following locations:

- Bridge.
- Cargo transfer control station.

- Engine room.

The STS operations plan should be drafted in compliance with the standards described in *MARPOL Annex I* (as amended by Resolution MEPC.186(59), chapter 8: The Prevention of Pollution during Transfer of Oil Cargo between Oil Tankers at Sea, Regulations 40, 41, 42) and should contain the following information:

- A step-by-step description of the entire STS operation.
- A description of the mooring and unmooring procedures and arrangements, including diagrams where necessary, and procedures for tending the oil tankers' moorings during the transfer of cargo.
- A description of the cargo and ballast transfer procedures, including those used while underway or anchored and procedures for connecting and testing integrity of cargo hoses and hose to manifold interface, topping off cargo tanks and disconnecting cargo hoses.
- The titles, locations and duties of all persons involved in the STS operation.
- Procedures for operating the emergency shutdown and communication systems and for rapid breakaway.
- A description of the drip trays and procedures for emptying them.
- Procedures for reporting spillages of oil into the water.
- An approved contingency plan.
- A cargo and ballast plan.

The Master should ensure that the STS operations plan on board is current and should require all personnel on board to follow the procedures in the plan.

A2.2 Notification to and approval from authorities

The regulations require that, for STS operations that are planned to be undertaken within the territorial sea or the EEZ of a party to the Convention, the Master, owner or agent of each tanker involved is required to notify the relevant coastal State authorities not less than 48 hours in advance of the scheduled operation. The notification should include the following:

- Name, flag, call sign, IMO number and estimated time of arrival (ETA) of the oil tankers involved in the STS operations.
- Date, time and geographical location at the commencement of the planned STS operations.
- Whether STS operations are to be conducted at anchor or underway.
- Oil type and quantity.
- Planned duration of the operation.
- Identification of STS operations service provider or person in overall advisory control (POAC) and contact information.
- Confirmation that the oil tankers have an approved STS operations plan.

In exceptional cases, where the above information is not available 48 hours in advance of the scheduled operation, the oil tanker discharging the oil cargo is required to provide notification, not less than 48 hours in advance, that:

- An STS operation will occur.
- The required information will be provided at the earliest opportunity.

If the ETA of an oil tanker at the location changes by more than six hours, the Master, owner or agent is required to provide a revised ETA to the relevant coastal State authority.

A4.3.2 *Advice to be given to the ships by the organisers*

In addition to the information included in section 4.3.2, vessels should be advised of the identification of the POAC and should receive confirmation that the POAC is qualified in accordance with the guidance contained in the *Manual of Oil Pollution* (reference 12) (see also section 1.7).

A10 Emergencies

Emergency duties

Each oil tanker should assign emergency duties to designated members of the crew in case of accidents that may arise during the transfer of oil, particularly in the case of spillages, when the guidance included in the ship's Shipboard Oil Pollution Emergency Plan (SOPEP) shall be followed.

A table similar to that shown as A1, containing emergency duties assigned to designated members of the crew, may be used as general guidance:

Table A1: Example of emergency duties allocation

The allocated duties are to be assigned by the ship management team based upon the anticipated manpower workload for the scheduled operations, having due regard to the provisions regarding prevention of fatigue referred to in accordance with requirements of the relevant ILO (regulation 2.3 Standard A2.3 of the Maritime Labour Convention 2006 (or equivalent)), *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)* (reference 9) and national regulations.

A copy of the allocated duties table should accompany the STS operations plan posted in the bridge, cargo control room and engine control room.

Emergency notifications

The STS operations plan should include details of the company specific contacts that require notification in the event of any shipping emergency, plus guidance to notify the following parties:

- Notifiable parties referred to in the ship's current voyage orders.
- Port contacts as listed in the ship's copy of the SOPEP.
- Responsible National Authorities as listed in Annex 2 of the SOPEP in accordance with the latest MSC-MEPC Circular.

Appendix B: Additional considerations for ship to ship transfers involving *MARPOL* Annex II cargoes (chemicals)

Note: The paragraph numbering used reflects the relevant section within the main body of the document to which the additional guidance in the appendix relates.

Ship to ship (STS) transfers of chemical cargoes are usually conducted in port and may involve a number of different receiving ships of variable size and complexity. Transfers to multiple vessels are a regular practice, often involving double banking on both sides of the mother ship. Furthermore, the discharging ship may be undertaking simultaneous operations, including the receipt and discharge of cargo and tank cleaning.

This appendix highlights some of the differences involved in chemical transfers and should be read in conjunction with the main text of the publication.

B1.5 Control of operations

Should an STS Superintendent not be appointed for an STS transfer of chemical products, the advisory control role of the Superintendent should be undertaken by one of the Masters, typically the Master of the mother ship.

B2.2 Notification to and approval from authorities

STS transfers involving chemical cargoes will normally be conducted within port areas and, depending on the products to be transferred, transfer organisers may need to notify and supply an operations plan to the harbour authorities, possibly national government agencies and, if alongside, to the facility owner or terminal operator. The cargo product name as per the certificate of fitness, not the commercial name, should be used when notifying authorities. The transfer of some types of cargo may only be permitted in specially designated areas. Transfer organisers should identify any special restrictions and regulations that need to be complied with, along with any requirements of the particular terminal.

The local authority's permission will usually include explicit requirements for:

- Designation of the STS Superintendent.
- Day or night cargo operations restrictions.
- Day or night vessel movement restrictions.
- Tank cleaning/ventilating restrictions during cargo transfer.
- Ballast water management.
- Emergency response and notification in the event of fire, spill or medical incidents.
- An approved fire and safety patrol vessel supplied and active during all STS operations.
- Approved *MARPOL* Annex II surveyors, for any prewash requirements on discharge and the approval of barges, trucks or terminal slop tank reception facilities.

B4.3 Pre-arrival communications

STS instructions

The STS organiser should prepare a general set of instructions for the STS operations. A copy of these general instructions should be transmitted in advance to the STS Superintendent and Masters of all vessels to berth alongside the discharging ship. The instructions should detail information that may include:

- Name and call signs of the discharging ship and all vessels to berth alongside.
- Location/position of the transfer operation and water depth.
- Identification and contact details of the STS Superintendent.
- Details of the planned transfer operations and expected sequence of vessels alongside the discharging ship.
- Cargo details for each vessel.
- Details of equipment required, including fendering, lifting equipment, hoses and connections.
- Applicable local regulations.

B7.3 Planning for cargo transfer

In addition to the items listed in section 7.3, the following should also be agreed for bulk liquid chemical transfers:

- Applicable port regulations and terminal requirements.
- Personnel transfer.
- Inerting and final cargo padding.
- Sampling procedures.
- Pre-wash requirements.
- Tank washing.
- Any relevant simultaneous operations taking place on either vessel.

Solidifying cargoes/insulation/heat dangers

Cargoes with a freezing/solidifying point higher than the ambient temperature must be heated to remain liquid. The vessels involved in the STS transfer operation should exchange information on maximum/minimum temperatures expected during cargo transfer and any limitations imposed due to cargo tank, pipeline and/or hose design.

Where effective insulation is not provided for pipelines and flanges, the crews on the vessels involved should be made aware of the associated safety hazard. In addition to the likelihood of the cargo solidifying in the cargo line, the pressure in the vapour space of the cargo tank should be closely monitored to determine the possibility of vapour solidifying in the vent line and/or pressure/vacuum (P/V) valves. Thermal stress to the vessel's tanks and pipelines should be minimised by commencing operations slowly and gradually increasing to the agreed transfer rate and temperature.

In the event that the cargo flow is unexpectedly stopped, the vessels involved should immediately take steps to clear the cargo lines to avoid any freezing/solidifying and blocking of the cargo system.

Figure B1: Chemical ship to ship transfer (mother ship moored to buoys)

Tank cleaning

For the mother ship, an STS transfer operation will often involve both loading and discharging and this may necessitate tank cleaning. For vessels alongside there may be occasions where tank cleaning is necessary, particularly for cargoes requiring pre-wash as per *MARPOL Annex II*. The consent of the STS Superintendent, the terminal and the harbour authority should be obtained prior to commencing tank cleaning operations. The other vessels should be informed of the nature of the product being washed, (anticipated) time of commencement and completion and any other relevant safety information.

On completion of washing, and prior to ventilating, consideration should be given to the climatic conditions and wind direction. Particular attention should be paid to the differing cargo deck levels of the mother ship and vessels alongside to avoid creating any vapour clouds over cargo deck areas and accommodation blocks. Notification should be given to all vessels alongside prior to the ventilation of any cargo tank and the atmosphere should be monitored for toxicity and flammable vapour. In the event of toxicity rising above the permitted threshold limit value (TLV), or flammable vapour being detected, all ventilation should be stopped immediately.

For cargoes requiring pre-wash procedures as per *MARPOL Annex II* and where the pre-wash is to take place while alongside, the authorities should be notified in advance so as to have the authorised surveyor in attendance on completion of discharge. Where the vessel is to discharge the pre-wash to a slop barge for transportation to a reception facility, the barge should moor and conduct operations in accordance with the recommendations contained in this Guide.

B7.4 Cargo transfer – general guidance

Vapour control

In addition to the requirements of the *IBC Code* chapter 15 (reference 11), local regulations may require that the transfer of certain toxic or otherwise hazardous products utilises a return vapour line. Return vapour hoses should be of a construction and material compatible with the product to be handled. The handling, connection and support of return vapour hoses should follow the same guidance as that for cargo hoses.

The pre-transfer meeting should consider the additional precautions to be taken for return vapour, i.e. pressure control of the tank atmospheres on both vessels. The transfer rate should be adjusted to ensure that pressure and vacuum limits for the tanks are not exceeded and excessive pressure or vacuum does not result in a release of toxic vapour to the atmosphere or ingress of air into the tank.

B7.5 Operations after completion of cargo transfer

Clearing lines and disconnecting

In accordance with *MARPOL Annex II*, the discharging vessel should strip the tanks of all product and clear the lines and hoses to the receiving vessel. This process should be carried out in accordance with the vessel's procedures and arrangements manual. To avoid any introduction of air, nitrogen should be used for clearing the lines and hoses. The pressure hose supplying the nitrogen should be fitted with a non-return valve.

The process of clearing lines should be carried out with the responsible persons of both vessels in attendance. Line clearing should not be commenced until the responsible person on the receiving vessel is present and in charge of the operation. The receiving vessel should ensure that there is sufficient ullage space to accept the remaining volume and should constantly monitor the tank ullage and pressure. If a return vapour line is in use, the discharging vessel should also monitor tank pressures carefully.

During clearing of cargo lines, transfer hoses should be adjusted to facilitate effective draining and avoid the possibility of them becoming trapped between the vessels' hulls.

Once lines and hoses are cleared of product, the receiving vessel should close the manifold valves on both cargo and vapour systems. All pressure from the hoses should be released back to the discharging vessel and all valves closed. Simultaneously, and in the same sequence, manifold valves on the vapour system should be closed. Hoses should then be disconnected and recovered by the vessel supplying them. Cargo and vapour manifold flanges should be blanked off. Hoses that are not to be immediately re-used for tank or line cleaning should also be securely blanked.

Precautions

- Communication between vessels should be established and maintained throughout the line clearing operation. A crew member should be assigned to the valve controlling the pressure and be ready to shut off the supply at any time.
- Safety of personnel should be ensured at all time by using the appropriate personal protective equipment (PPE) for the cargo being handled. Personnel not involved in the line clearing operation should be restricted from entering the area.
- Potential pollution hazards should be identified to all personnel engaged in the line clearing operation.
- Pressure should be controlled at all times to prevent cargo overflowing and to prevent over-pressurisation of cargo tanks.

Appendix C: Additional considerations for ship to ship transfers involving liquefied petroleum gas cargoes

Note: The paragraph numbering used reflects the relevant section within the main body of the document to which the additional guidance in the appendix relates.

The primary focus of this appendix is the transfer of liquefied petroleum gas (LPG) (butane and propane), ammonia and propylene. This guidance may be useful for cargoes such as ethylene and other chemical gases, but a specific risk assessment should be carried out in each case and any additional measures deemed necessary should be taken.

For additional guidance on the side-by-side transfer of LPG between floating (production) storage and offloading (FPSO) facilities and conventional gas tankers, reference should be made to *The Safe Transfer of Liquefied Gas in an Offshore Environment (STOLGOE)* (reference 22).

C7.3 Planning for cargo transfer

In addition to the items contained in section 7.3, the planning of STS transfers involving LPG cargoes should include information on the following:

- Line cooling requirements.
- Initial transfer rate.
- Maximum transfer rate and pressure.
- Procedures for the use of a booster pump.
- Agreed procedures if blending or mixing is to be employed.
- Maximum allowable relief valve settings (MARVS), including port and sea settings.
- Procedures agreed for vapour management.
- Emergency shutdown (ESD) arrangements.
- Manifold valve closing time.
- Contingency plans for emergencies such as leakage or spillage.
- Cargo odourisation during transfer.

During cargo transfer, the maximum transfer rate should be kept consistent with the receiving ship's reliquefaction capacity. Alternatively, a vapour return hose connection should be made between the ships.

Procedures for heating cargo, if transferring from refrigerated to pressurised storage, should also be taken into account.

C7.4 Cargo transfer – general guidance

Vapour return

As with other LPG cargo transfer operations, there are safety advantages in providing a vapour return connection between ships.

The vapour return can limit the need for vapour release to atmosphere and can act as a safety release, or can be used to limit the need for reliquefaction. Furthermore, it may improve the transfer rate. However, while recommended, a vapour return connection is not essential for LPG STS transfer operations and has the potential to lead to cargo contamination.

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C7.5 Operations after completion of cargo transfer

After completion of cargo transfer the following operations should be carried out:

- All hoses purged into one or other ship prior to disconnecting.
- Hoses disconnected, taking precautions to ensure that no liquid is left in the cargo transfer system. The pressure in the system should be released through a bleed valve or through the drain line into the vapour return line.
- Cargo manifolds and cargo hoses securely blanked.
- Where required, authorities informed of completion of cargo transfer and the anticipated time of unmooring.

The following is a typical hose purging procedure:

- Drain the hose of liquid.
- Discharging ship to blow hot vapour through the hose.
- Discharging ship to purge the hose with nitrogen.
- Close the manifold valves on both ships and the hose-end valve.

Cargo documentation and customs requirement

Companies should advise their Masters of customs' documentation requirements. It is normal for the quantity transferred to be agreed between both Masters in accordance with their individual company's instructions.

C9.2 Cargo transfer hoses

Hose standards

Hoses used in LPG STS operations should be specially designed and constructed for the product being handled and the purpose for which they are being used.

Where cargo hoses are used, they may be supplied by an STS service provider or by one of the vessels involved in the cargo transfer. In either event, continuous control and monitoring of cargo hoses is essential.

Hoses used should comply with *IGC Code* (reference 10) requirements and, in addition, should comply with an appropriate standard, examples of which are listed below. However, these are subject to change and the most up-to-date version should be consulted.

Composite hoses	- *BS EN 13766:2010* (reference 27)
Metallic hoses	- *ISO 10380:2003* (reference 24)
Rubber hoses	- *ISO 2928:2003 / BS EN 1762:2003* (references 25 and 30)

The characteristics, testing, inspection and storage requirements of the hoses should be known and will include hose standards and inspection and testing requirements:

- Design characteristics and the use of hoses with leak before failure capability.
- In-service testing procedures developed in line with manufacturer's recommendations, but in any event at intervals not exceeding 12 months, or as necessary to prove the integrity of the hose prior to use.

Records of testing and inspection should be maintained.

Hoses should be stored in accordance with manufacturer's recommendations and in a manner to minimise the possibility of mechanical damage or the entrapment of moisture.

A certificate from the certifying authority, for example a Classification Society, should be available for each hose.

Flow velocities

In establishing the maximum flow rate during STS transfers, consideration should be given to:

- Limitations set by the hose manufacturer.
- Limitations of both ships' cargo systems.

Flow velocities should not exceed 12 m/s.

C10.1 Contingency planning and emergency response procedures

Emergency shutdown and emergency release couplings

A detailed assessment of the need for a linked emergency shutdown (ESD) system and for the use of emergency release couplings (ERC) should be made. Factors to be considered in the assessment include the number of hoses in use and the time required to disconnect them in an emergency.

Testing of emergency shutdown systems

Testing of emergency shutdown systems

Both ships should test their emergency shutdown (ESD) systems not more than 48-hours before STS operations commence and should advise the STS Superintendent of successful completion of these tests. The tests should be documented in accordance with the STS procedure.

Appendix D: Additional considerations for ship to ship transfers involving liquefied natural gas cargoes

Note: The paragraph numbering used reflects the relevant section within the main body of the document to which the additional guidance in the appendix relates.

These additional considerations directly address the side-by-side ship to ship (STS) transfer operations of liquefied natural gas (LNG) between LNG carriers at anchor, alongside a shore jetty or while underway. Transfer systems should be designed and constructed to comply with the guidance in EN 1474-3 (reference 29).

The guidance applies to seagoing ships and may also be useful for reference when establishing rules and procedures for transfer operations between seagoing ships and LNG regasification vessels (LNGRV) or LNG floating storage and offloading (FSO) vessels in inshore waters.

In preparing this guidance, due regard has been made to technical and safety issues concerning side-by-side STS transfer operations of LNG, but the intellectual property position relating to the transfer process or equipment used in it has not been reviewed. It is for the operators of ships undertaking side-by-side STS transfer, or lightering, of LNG to consider whether there are any intellectual property issues that they should consider in the jurisdiction where the transfer takes place.

D1.5 Control of operations

Should an STS Superintendent not be appointed for an STS transfer of LNG, the advisory control role of the Superintendent should be undertaken by one of the Masters.

D7.2 Responsibility for cargo operations

During the cargo transfer operation two officers on each ship should be assigned cargo duties, for example, Chief Officer or gas/cargo engineer assisted by a deck officer.

D7.3 Planning for cargo transfer

The LNG cargo transfer operation should be subject to normal cargo planning processes prior to the operation and the plan should be agreed in writing between the two ships.

In addition to the items contained in section 7.3, the planning of STS transfers involving LNG cargoes should include information on the following:

- Quantity to be transferred, including quantities onboard before and after transfer.
- Cargo and cargo tank temperatures.
- Estimated saturated vapour pressure (SVP) of the cargo to be transferred.
- Cool down procedures.
- Initial transfer rate.
- Maximum transfer rate.
- Vapour pressure differentials and maximum allowable values.
- Procedures for the control of vapour pressures.
- Draining and purging procedures.

- Local or government rules that apply to the transfer.
- If applicable, sloshing zones and a contingency plan for internal cargo transfer in the event of a prolonged interruption of cargo transfer.

D7.4 Cargo transfer – general guidance

Vapour management

Close liaison on vapour management should be maintained between the vessels and a methodology should be agreed prior to the start of the transfer to ensure no vapour is released to the atmosphere. Both Masters should clearly understand each vessel's boil off gas (BOG) burning capacities. The overall vapour load during the cool down of the cargo transfer system may be reduced by pre-cooling the vessels' liquid headers prior to mooring, provided that the manifolds on the vessels are isolated by double block valves.

Line inerting (after connection)

Once the cargo transfer equipment has been connected and all transfer lines have been purged using nitrogen, the connections should be pressurised and tested. Purging should be considered complete when the oxygen level at the outlet has reduced to less than 5% by volume.

Transfer line cool down

The use of one or more cargo spray pumps, set up to recirculate back to their respective tanks, is recommended for the cool down of the cargo transfer lines. At the start of the cool down of the cargo transfer lines, particular attention should be paid to the integrity of cargo lines, the manifold area, flange connections and the cool down rate. Increases in the flow rate should be at the receiving vessel's request. Cool down should be considered complete when the liquid lines, manifold and transfer lines on both vessels have reached an agreed temperature.

Vessel motion and weather criteria

Vessel motions are recognised as having the potential to generate damaging impacts from sloshing within partially filled LNG cargo tanks having membrane cargo containment systems. For this reason, LNG vessels fitted with membrane cargo containment systems normally operate within safe upper and lower fill levels. Cargo loading and discharge operations at conventional LNG terminals are typically carried out in sheltered locations. The environmental limits are normally set by the requirements to maintain safe mooring loads and to limit vessel movement at the berth. Within these constraints, it is generally regarded that sloshing impacts do not pose a risk and a specific sloshing risk assessment is not normally undertaken for LNG carriers at conventional LNG terminals.

Although the same principle might be applied to STS operations performed at anchor or underway, the same environmental limits are not directly applicable. In this case, the mooring constraints are subject to the relative motion between the two vessels, rather than the motion of one vessel.

In general, for a given STS operation, an assessment of the risks from sloshing impacts should be performed, and should include consideration of the following information:

- Environmental data for the STS area, including significant wave height, wave period, wave heading, velocities of currents and wind data.
- Details of the involved vessels' operating profiles including the duration and frequency of the STS operation and any environmental operating limits or restrictions.

Owners should be guided by their Classification Societies and the containment system designer regarding the risk of sloshing damage and safe operational parameters. Consideration should be given to numerical and/or physical modelling of the vessels' motions and resultant sloshing loads for expected environmental conditions and, if insufficient data is available to perform such detailed analysis, a sheltered location should be selected. It should be noted that LNG vessel responses to relatively low significant wave heights (Height <1 m) can be substantial, particularly if the wave period is long (in excess of 10 seconds).

Topping off

LNG cargo tanks might be loaded to levels in excess of 98% capacity when the operation takes place alongside a shore terminal. However, in open waters there is the potential for greater vessel motions, thereby risking activation of the tank protection and/or emergency shutdown (ESD) systems by high tank levels at lower cargo volumes. This should be considered when developing the cargo transfer plan.

The topping off of cargo tanks should be carried out at a reduced rate, one tank at a time in the sequence agreed with the discharging vessel during pre-transfer discussions. The receiving vessel should request decreases in flow rate.

D7.5 Operations after completion of cargo transfer

Draining and purging of cargo transfer lines

On completion of cargo transfer, all cargo transfer lines should be drained and then purged with nitrogen until a reading at the disconnection point of less than 2% methane by volume is detected. The cargo transfer equipment may then be disconnected and blanked.

Certain composite hose types are known to entrain small quantities of vapour within the inner layers of material. Procedures should be developed to ensure a non-flammable atmosphere is maintained within the hoses after disconnection. This should entail the fitting of end blanks and additional purging.

Further information on the draining and purging of transfer systems is contained in the SIGTTO briefing paper *LNG Transfer Arms and Manifold Draining, Purging and Disconnection Procedure* (reference 33).

Cargo documentation and custody transfer requirements

Custody transfer measurement surveys should be made on board both vessels.

D9.2 Cargo transfer hoses

Where cargo hoses are used they may be supplied by the STS service provider or by one of the vessels involved in the cargo transfer. In either event, continuous control and monitoring of cargo hoses is essential.

The characteristics, testing, inspection and storage requirements of the hoses should be known and should include:

- Design characteristics and the use of hoses with leak before failure capability.
- Consideration of the need for additional support to be provided for LNG hoses.
- In-service testing procedures developed in line with manufacturer's recommendations, but in any event at intervals not exceeding 12 months or as necessary to prove the integrity of the hose prior to use. Records of testing and inspection should be maintained.
- Storage of hoses as per manufacturer's recommendations and in a manner to minimise the possibility of mechanical damage or the entrapment of moisture.

A certificate from the certifying authority should be available for each hose.

Marking and documentation

As a minimum, each transfer hose should be permanently marked with the following information and be compliant with the requirements of *EN1474* (references 28 and 29) and other applicable regulations, such as the *IMO IGC Code* (reference 10):

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- Hose serial number.
- Internal diameter of the hose.
- Overall weight of complete hose.
- Date of manufacture.
- Date of proof pressure testing.
- Certifying authority stamp.
- The maximum working pressure.
- The maximum flow rate.
- The maximum and minimum allowable working temperature range.

The hose vender should provide the following documents:

- Hose certificate.
- Hose quality assurance manual.

- Inspection, test and storage plan.
- Operating manual.
- Hose handling manual.

Cargo transfer hard arms

Where hard arms are considered for use in LNG STS transfer operations, the following should be taken into account:

- Accelerations.
- Permissible manifold loadings.
- Arm working envelope.
- Arm support arrangements.
- Arm stowage arrangements.
- The effect of vibration on the arm.
- Maintenance requirements.
- Size of the arm.
- Connectability.
- Vertical and horizontal vessel movement.
- Allowable flow velocity and pressure loss.
- Testing requirements.

Additional hull protection

Based upon the transfer system employed, a full evaluation should be made of the need to extend the hull area protected by water in case of cargo spills.

D10.1 Contingency planning and emergency response procedures

Emergency release system activation location

The operating station for manual emergency release system (ERS) activation should be situated in a safe location away from the manifold area. Step by step operating instructions should be permanently attached to the equipment and all personnel involved in its operation should be trained and familiar with its correct use.

Additionally, clear procedures should be in place to identify the process for authorisation to activate the ERS.

Operating manuals should contain operating instructions, testing and inspection schedules and any limitations of the ERS. Records of tests, inspections and use of the ERS should be maintained on the vessel.

Routine inspection of the ERS equipment should be carried out throughout the cargo transfer. The release system should be provided with suitable means to protect against accidental activation.

Hose handling after emergency release coupling release

If the length of the hose string is such that, after release by the emergency release coupling (ERC) it would impact either vessel with such force as could cause damage to the vessel or effect the integrity of the hose, hose handling system, manifolds or ERC, then a hose handling system should be provided. The system should be capable of handling and controlling the cargo transfer hoses in their charged, cryogenic condition. In addition, the hoses and hose handling system should be capable of absorbing all shock loads imposed by the simultaneous release of multiple transfer hoses. If an unrestrained release would cause the loading limits of the manifolds to be exceeded, a restraint system should be fitted to transfer the load to another part of the vessel.

The system should ensure complete disconnection and, as far as practicable, ensure that the released hoses do not contact the metal structure of the ship. This would reduce the risk of sparking at the contact point, injury to personnel or mechanical damage.

Deadship emergency release coupling activation

To ensure that the mechanical integrity of the transfer system is not compromised during emergency scenarios, the release system should be able to function under a deadship condition (i.e. no motive power is available from the ship systems). In addition, the ERS should be capable of releasing the transfer lines automatically before their safe working envelope is exceeded.

Transfer system inspection and testing

The transfer system, comprising all equipment necessary to permit safe transfer of LNG between the vessels, should be subject to periodic testing. Frequency of the transfer system testing should be in accordance with the manufacturer's recommendations, or more frequently if so determined by the vessel operators.

Emergency shutdown systems

Linked emergency shutdown systems

Linked ESD systems are used in the LNG shipping industry and enable terminals and ships to execute a controlled rapid shutdown of the cargo transfer operation in abnormal or emergency situations. A linked ESD system should be used for LNG STS cargo transfer. As far as is practical, during cargo transfer operations all vessels should conform to the basic philosophy for ship/shore ESD set out in *ESD Arrangements and Linked Ship/Shore Systems for Liquefied Gas Carriers* 2009 (reference 8).

Emergency shutdown system compatibility, connection and use

A detailed assessment should be made of the compatibility of the ESD systems of the participating ships, including confirmation of connector pin/channel allocations, as appropriate.

Electrical or optical systems offer near instantaneous activation of both ships' ESD systems under trip conditions, and also provide high reliability and continuous connection between the two cargo control room hotline telephones.

A pneumatic system may be used as a back-up to the electrical or optical ESD.

In all cases, the cause and effects of ESD system activation should be discussed and agreed. In addition, both vessels should discuss and agree actions in event of ESD activation, including vapour management procedures. ESD communication channels may need to be reconfigured to ensure system functionality.

Telephone links provided via the appropriate ESD link may be incorporated into communications planning discussions, as appropriate.

Emergency release system

An ERS, consistent with dry-break philosophies, should be provided in accordance with the following guidance:

- Each transfer line should be fitted with an ERC.
- The ERC should be designed utilising two valves, one upstream and one downstream of the coupling.
- The ERS should be capable of operation and release of all transfer lines in the event of a ship blackout and the non-availability of ship provided services.

- In all cases, ESD 1 and ESD 2 should be interlocked such that ESD 2 is not possible without ESD 1 being initiated. Step by step activation procedures should be clearly posted at the ERS operating location.
- A system should be in place to ensure activation of any ERS is not initiated before the ESD trip signal has been issued on both ships.
- In the event of the ships breaking away, the ERS should automatically operate and release the transfer lines before the maximum operating limits of hoses/arms are reached. Equipment should also be in place to enable manual activation of the ERS.
- The system should be designed such that operation will not result in unacceptable surge pressure in vessel piping. Refer to *Guidance for the Alleviation of Excessive Surge Pressures on ESD* (reference 7) for further information.
- A key objective is to avoid sparking, so full consideration should be given to the resultant effect upon the hose/arm ends if there is an emergency release.

- Systems should be designed and procedures developed to minimise the possibility of spurious operation.

Testing of emergency shutdown systems

Both ships should test their ESD systems not more than 48 hours before STS operations commence and should advise the STS Superintendent of successful completion of these tests. The tests should be documented in accordance with the STS procedure.

Before STS cargo transfer commences, the ESD systems on both vessels should be re-tested to ensure correct system operation and to prove that ESD trip signals can be communicated between the ships.

The mechanical release mechanism of the ERS should be proven operational and ready for use before cargo transfer commences. Tests of the system should prove all components, with the exception of actually releasing the ERC. The system that ensures that ESD 1 occurs prior to ESD 2 should be tested and proven operational. The actual physical operation of the ERC to verify separation should be tested once per year, or as per manufacturer's recommendations, whichever is the more frequent.

Appendix E: Operational/safety checklists

At sea ship to ship operations:

Checklist 1 - Pre-fixture information (for each ship)

Checklist 2 - Before operations commence

Checklist 3 - Before run-in and mooring

Checklist 4 - Before cargo transfer

Checklist 5 - Before unmooring

In port STS operations:

Checklist 6 - An example of a pre-transfer checklist

Checklist 6A - An example of checks during transfer

AT SEA SHIP TO SHIP TRANSFER
CHECKLIST 1 – PRE-FIXTURE INFORMATION (FOR EACH SHIP)
(BETWEEN SHIP OPERATOR/CHARTERER AND ORGANISER)

<table>
<tr><td>Ship Operator:</td><td colspan="2">Ship Charterer:</td><td>STS Organiser:</td></tr>
<tr><td colspan="2">Ship's Name:</td><td colspan="2">Company:</td></tr>
<tr><td colspan="2">Call Sign/INMARSAT No:</td><td colspan="2">Proposed Date of Transfer:</td></tr>
</table>

IMO Number:	Proposed Location:

	Discharging / Receiving Ship (Delete as appropriate)	Ship Operator's Confirmation	Remarks
1	Current vessel particulars questionnaire (VPQ) data has been exchanged		
2	State the anticipated maximum berthing displacement of the ship		
3	State the anticipated arrival draughts and freeboard		
4	If the berthing operation is to be conducted underway, confirm that the ship can maintain about five knots for a minimum of two hours		
5	The ship is able to conduct operations in accordance with the latest edition of the *Ship to Ship Transfer Guide*		
6	Sufficient manpower will be provided to ensure the safe conduct of operations while minimising the potential for fatigue		
7	Key vessel personnel can communicate in English. If not, state working language used		
8	The ship's manifold arrangement and lifting gear is in accordance with OCIMF or SIGTTO recommendations for the ship type/size		
9	State the maximum and minimum expected height of the cargo manifold from the waterline during the transfer		
10	The SWL and outreach of the ship's lifting equipment is sufficient for the intended operation		
11	Where applicable, a copy of the STS operations plan has been exchanged		
12	If not included within the STS operations plan, a general arrangement plan or other similar mooring diagram has been exchanged		

13	The location and number of enclosed fairleads and mooring bitts fitted on the ship is in accordance with *Mooring Equipment Guidelines* (reference 6)		
14	The ship is able to deploy all lines on winch drums		
15	Messenger lines of suitable strength will be available at each mooring location		
16	MSDS information has been exchanged		

16	MSDS information has been exchanged for the cargo being transferred and, where applicable, the previous cargo of the receiving ship		
17	Both sides of the ship are clear of any overhanging projections, including bridge wings		
18	Sufficient accommodation is available on board for STS personnel		
Additional for Oil Transfers:			
19	Confirm the vessel is equipped to conduct vapour balancing		
Additional for LPG Transfers:			
20	State the arrangement of liquid and vapour manifold connections		
Additional for LNG Transfers:			
21	STS Transfer Compatibility Questionnaire data has been exchanged		

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)

Name:	
Rank or Position in Company:	
Signature:	Date:

AT SEA SHIP TO SHIP TRANSFER

CHECKLIST 2 – BEFORE OPERATIONS COMMENCE

Discharging Ship's Name:

Receiving Ship's Name:

Name of Designated POAC:

Name of STS Superintendent if Different from POAC:

Date and Location of Transfer:

		Checked	Remarks
1	A copy of the completed checklist 1 has been received		
2	A copy of the JPO that encompasses the entire transfer operation has been received		
3	Personnel will comply with the hours of work and rest requirements of IMO and national regulations, as appropriate		
4	Radio communications, including back-up systems, have been agreed and tested and clocks have been synchronised between the ships		
5	The language of operations has been agreed		
6	The rendezvous position of the transfer area has been agreed		
7	Information on ship handling characteristics has been exchanged, including details of any critical main engine revolutions and corresponding speed		
8	Approach, manoeuvring and mooring plans are understood and confirmed		
9	Mooring procedures have been agreed, including fender positions and number/type of ropes to be provided by each ship		
10	The system and method of electrical isolation between the ships has been agreed		
11	The ship is upright and at a suitable trim, without any overhanging projections		
12	Manoeuvring, mooring and navigational equipment has been tested and found in good order		
13	Cargo transfer system safety devices, including IG and emergency shutdown (ESD) systems, where applicable, have been proven operational not more than 48-hours prior to the operation		

14	The ship's boilers and tubes have been cleared of soot and it is understood that during STS operations, tubes must not be blown		
15	Engineers have been briefed on engine speed (and speed adjustment) requirements		
16	Weather forecasts have been reviewed for		

	the transfer area and arrangements have been made for their continued receipt throughout the operation		
17	The hose lifting equipment is suitable and ready for use		
18	The cargo transfer hoses/arms have been tested and certified and they are in apparent good condition		
19	The fenders and associated equipment are visually in good order		
20	The crew has been briefed on the mooring procedure		
21	The contingency plan is agreed and an appropriate emergency drill has been conducted		
22	Local authorities have been advised of the STS operation		
23	A navigational warning has been broadcast		
24	Monitoring is in place for accommodation, void spaces, pumproom, compressor and motor rooms, as applicable, to detect possible flammable atmospheres		
25	The other ship has been advised that checklist 2 is satisfactorily completed		
Additional for LNG and LPG transfers:			
26	Cargo lines have been cooled		

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)

Name:

Rank:

Signature:

Date:

**Note that items 17, 18 and 19 can only be checked by the vessel that has them onboard.*

This form should not be substituted for other required checklists. If this form is used, it should be used in its entirety.

AT SEA SHIP TO SHIP TRANSFER
CHECKLIST 3 – BEFORE RUN-IN AND MOORING

Discharging Ship's Name:

Receiving Ship's Name:

Name of Designated POAC:

Name of STS Superintendent if Different from POAC:

Date and Location of Transfer:

		Checked	Remarks
1	Checklist 2 has been satisfactorily completed		
2	Primary fenders are correctly positioned and fender rigging is in order		
3	If required, secondary fenders are correctly positioned and secured		
4	There are no overhanging projections on the side of berthing		
5	A proficient helmsman is at the wheel		
6	Cargo manifold connections are prepared, blanked and marked		
7	Course and speed information has been exchanged and agreed		
8	The method for controlling the ship's speed adjustment, e.g. by changes to revolutions, propeller pitch or by telegraph, has been agreed		Specify method
9	Navigational signals are displayed		
10	Adequate lighting is available		
11	Power is available for winches and they are in good order		
12	Rope messengers, rope stoppers and heaving lines are ready for use		
13	All mooring lines are ready		
14	Fire axes, or suitable cutting equipment, are in position at the fore and aft mooring stations		
15	Crew are standing by at their mooring stations		
16	Communications are established with mooring personnel and with the other ship		

17	Fire-fighting and anti-pollution equipment is ready for use		
18	Shipping traffic in the area is being monitored		
19	The vessel status has been appropriately set on the Automatic Identification System (AIS)		

20	The other ship has been advised that checklist 3 is satisfactorily completed		

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)	
Name:	
Rank:	
Signature:	Date:

This form should not be substituted for other required checklists. If this form is used, it should be used in its entirety.

AT SEA SHIP TO SHIP TRANSFER
CHECKLIST 4 – BEFORE CARGO TRANSFER

Discharging Ship's Name:

Receiving Ship's Name:

Name of Designated POAC:

Name of STS Superintendent if Different from POAC:

Date and Location of Transfer:

		Checked	Remarks
1	Checklist 3 has been satisfactorily completed		
2	A standard pre-transfer checklist, such as the *ISGOTT* ship/shore safety checklist or equivalent, has been satisfactorily completed and arrangements have been made for repetitive checks during the transfer		
3	Required regional checklists have been completed		
4	Procedures for the transfer of personnel have been agreed		
5	If used, the gangway is correctly positioned and well secured		
6	Inter-ship communication systems, including back-up, are agreed and tested		
7	Emergency signals and shutdown procedures are agreed		
8	The engine room will be manned as required throughout the transfer and the main engine maintained on standby or on short notice of readiness		
9	A bridge watch and/or an anchor watch is established		
10	Officers in charge of the cargo transfer on both ships are identified and details have been exchanged and posted		
11	A deck watch has been established to pay particular attention to moorings, fenders, hoses, manifold areas and overside		
12	The initial cargo transfer rate has been agreed with the other ship		
13	The maximum cargo transfer rate is agreed and recorded, taking into account the maximum flow rates of the transfer system, including hoses		

14	Arrangements have been made for the regular exchange of information on quantities of cargo transferred		
15	The topping-off rate has been agreed and recorded		

16	The procedure for stopping transfer is agreed		
17	Ballasting and deballasting arrangements are agreed		
18	Cargo hoses are well supported and protected from chafing and the hose release area is clear of obstructions		
19	Tools required for rapid disconnection are located at the cargo manifold		
20	Messengers are prepared and positioned ready for unmooring in accordance with the unmooring plan		
21	Details of the previous cargo of the receiving ship, including any hazardous or toxic properties, have been given to the discharging ship		
22	Security information has been exchanged and, if required, a Declaration of Security has been completed		
23	The other ship has been advised that checklist 4 is satisfactorily completed		
Additional for LNG and LPG transfers:			
24	Cool down procedures have been agreed		
25	Vapour differentials and maximum pressures have been agreed		
26	Procedures for increasing/reducing transfer rates have been agreed		
27	Procedures for the control of vapour pressure have been agreed		
28	The potential for cargo roll-over has been considered		
29	Where fitted, ESD links or pendant arrangements are in place and tested		
30	The deck watch is aware of the location and activation method of ESD systems on deck		
31	Cargo safety and monitoring systems are operational		

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Additional for LNG transfers:			
32	ESD 1 and ESD 2 system arrangements are in place and tested:		

	• ESD 1 warm test has been undertaken • ESD 1 cold test has been undertaken • ESD 2 release mechanism only (with no coupling breakaway) has been tested		
33	Cargo transfer lines have been purged with nitrogen to below 5% O_2		
34	Cargo transfer line connections are confirmed tight		
35	The nitrogen plant will be operational throughout the transfer		
36	The protective water curtain is fully operational		

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)	
Name:	
Rank:	
Signature:	Date:

This form should not be substituted for other required checklists. If this form is used, it should be used in its entirety.

AT SEA SHIP TO SHIP TRANSFER

CHECKLIST 5 – BEFORE UNMOORING

Discharging Ship's Name:

Receiving Ship's Name:

Name of Designated POAC:

Name of STS Superintendent if Different from POAC:

Date and Location of Transfer:

		Checked	Remarks
1	Cargo hoses are properly drained prior to hose disconnection		
2	Cargo hoses or manifolds are securely blanked		
3	The transfer side of the ship is clear of obstructions (including hose lifting equipment)		
4	The method of letting go moorings and separation of ships has been agreed and crew have been briefed on procedures		
5	The fenders, including fender rigging, are in good order		
6	Secondary fenders are correctly positioned and secured for departure		
7	Power is available for mooring winches		
8	Rope messengers and rope stoppers are available at all mooring stations		
9	Crew are standing by at their mooring stations		
10	Communications are established with mooring personnel and with the other ship		
11	Shipping traffic in the area is being monitored and a very high frequency (VHF) alert has been transmitted		
12	Manoeuvring, mooring and navigational equipment has been tested and is ready for departure		
13	Mooring personnel have been instructed to let go only as directed by the Master		
14	Agreement has been reached that navigational warnings will be cancelled and AIS status updated when clear of the other ship		
15	The other ship has been advised that checklist 5 is satisfactorily completed		

Additional for LNG transfers:			
16	Cargo hoses are properly isolated, drained		

	and purged with nitrogen prior to disconnection		

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)	
Name:	
Rank:	
Signature:	Date:

This form should not be substituted for other required checklists. If this form is used, it should be used in its entirety.

CHECKLIST 6

AN EXAMPLE OF A PRE-TRANSFER CHECKLIST FOR IN PORT STS CARGO TRANSFER

AN EXAMPLE OF A PRE-TRANSFER CHECKLIST FOR IN PORT STS CARGO TRANSFER

Discharging Ship's Name:

Receiving Ship's Name:

Name of STS Superintendent:

Date and Location of Transfer:

		Discharging Ship Checked	Receiving Ship Checked	Terminal Checked
1	A standard pre-transfer checklist, such as the *ISGOTT* ship/shore safety checklist or equivalent, has been satisfactorily completed and arrangements have been made for repetitive checks during the transfer			
2	Required regional checklists have been completed			
3	Written permissions for cargo operations to take place are available to all Responsible Persons			
4	The formal risk assessment has been communicated by the transfer organiser and reviewed by involved parties			
5	The general contingency plan for the cargo transfer operation has been communicated by the transfer organiser and reviewed by involved parties			
6	Security information has been exchanged and, if required, a Declaration of Security has been completed			
7	Suitable fenders are rigged correctly to prevent contact of the vessels			
8	Fire axes, or suitable cutting equipment, are in place at the fore and aft mooring stations			
9	Present and forecast weather and sea conditions have been considered			
10	A means of access is in place to allow personnel to safely transit between the vessels			
11	Cargo specifications and any requirements for inerting, heating, reactivity and inhibitors have been exchanged			
12	The cargo transfer operation is to be completed under closed conditions			

13	Where applicable, procedures for vapour			

	control/balancing have been agreed			
14	All cargo monitoring systems, including level gauges, high level alarms, pressure gauges and alarms, have been tested and are operational			
15	Where necessary, permissions for tank cleaning have been obtained and procedures are in place			
16	Access to the cargo deck is restricted and controlled during cargo transfer operations			
17	All personnel engaged in the cargo operation are provided with appropriate PPE including, where necessary, personal gas detectors/monitors			
18	Cargo hoses have been pressure tested within the prescribed period and documentation is available on board			
19	The construction and material of the cargo hoses is suitable for the temperature and nature of the product(s)			
20	Where electrically continuous hoses are used, the hoses are connected to the vessel with the insulated flange before being passed to the other vessel for connection			
21	The cargo hose string is of adequate length and properly supported			
22	The cargo lines are lined up in accordance with the cargo operation plan			
23	Spill response equipment is on station and ready for immediate deployment			
24	Where applicable, fire-fighting provision has been made for unmanned barges			
25	Spaces to be routinely monitored for any build-up of flammable and/or toxic vapour have been identified			

	Signature	**Name**
Officer in Charge Discharging Ship		
Officer in Charge Receiving Ship		
Terminal		
STS Superintendent		

CHECKLIST 6A

CHECKLIST 6A

AN EXAMPLE OF CHECKS DURING TRANSFER FOR IN PORT STS OPERATIONS

Discharging Ship's Name:

Receiving Ship's Name:

Name of STS Superintendent:

Date and Location of Transfer:

		Repetitive Check 1	Repetitive Check 2	Repetitive Check 3
1	Present weather and sea conditions are within the agreed limits			
2	Personnel engaged in the cargo transfer operation are wearing appropriate PPE			
3	Cargo hose strings, manifold connections and cargo systems are free of any leakage			
4	Cargo hoses are properly supported, taking into account changing freeboards and any movement between the vessels			
5	All cargo monitoring systems, including level gauges, high level alarms, pressure gauges and alarms, are functioning correctly			
6	The cargo transfer operation is continuing under closed conditions			
7	The sea surface around the vessels is periodically visually checked for any sign of pollution			
8	All identified spaces are being routinely monitored for any build-up of flammable and/or toxic vapour			
9	All mooring lines are correctly tensioned and managed during the cargo transfer operation			
10	Where rigged in accordance with local requirements, emergency towing-off pennants are adjusted throughout the cargo transfer operation			
11	On completion of cargo transfer to or from a tank, the tank is secured			
12	Levels in all cargo and ballast tanks, including those not being worked, are routinely monitored			
Checked by:				
Date and Time:				

Appendix F: Example checklist for personnel transfers by crane

SHIP TO SHIP TRANSFER
CHECKLIST FOR PERSONNEL TRANSFERS BY CRANE

Ship's Name:

Date and Place of Transfer:

<table>
<tr><th colspan="5">A. Prior to Arrival at STS Location – Crane</th></tr>
<tr><td>1</td><td colspan="3">A visual inspection has been undertaken by a qualified person of all operating parts, including runner wire, sheaves, cargo block/hook, hydraulic piping, etc.
(Wires are lubricated with no signs of kinks, rust or nips. Wires are evenly stowed on the winch drum with no tangles or loops. Check hook swivel. Check wire rope terminations at hook and winch drum are in place and secure. Also refer to manufacturer's inspection recommendations)</td><td></td></tr>
<tr><td>2</td><td colspan="3">A full functional operating check has been performed, in accordance with the manufacturer's instruction manual, and all controls have been confirmed as operating satisfactorily.
(Wind speed and vessel movement suitable to perform operation?)</td><td></td></tr>
<tr><td>3</td><td colspan="3">All crane safety devices have been tested. The operation of limit switches, hook safety latch, brakes, etc has been checked.
(Cranes must be fitted with hoisting upper and lower limits, luffing upper and lower limits)</td><td></td></tr>
<tr><td>4</td><td colspan="3">The emergency mode of operation has been tested.
(Does the hoisting winch have an alternative means of lowering if the crane loses primary power? This can include emergency sources of power or manual operation (hand pump))</td><td></td></tr>
<tr><td>5</td><td>State date wire last replaced</td><td></td><td>State date of last load test</td><td></td></tr>
</table>

B. Prior to Arrival at STS Location – Personnel Transfer Basket (PTB)		
1	The PTB is certified for use	
2	A complete visual check has been performed of all components of the PTB in accordance with manufacturer's guidance (Checks should include the lifting ring, load line, safety load line, lifting sling and shock cords, aluminium rings, ultraline rigging line, splices, etc)	
3	Steel components have been inspected for deterioration, cracks, distortion, weld integrity, rust etc	
4	Tag lines are attached to the bottom outside of the basket in accordance with manufacturer's guidelines	
5	The condition of personal flotation devices (PFDs) has been checked and there are sufficient to ensure their availability for all personnel being transported (The PFD should be suitable for basket transfer, taking into consideration the height above sea level)	

C. Pre-Personnel Transfer Operation

1	All participants have been properly briefed to ensure that transfer procedures are understood	
2	All persons in direct control of the crane have completed on board training as per owner's requirements (The person operating the crane for personnel transfers should be an experienced crane operator and be fully familiar with the international crane hand signals).	
3	The officer in charge has confirmed that the personnel basket and crane have been inspected and tested before use, as per owner's instructions and manufacturer's guidance	
4	Sufficient personnel are available to perform the transfer safely (Cranes must only be operated by trained and certified personnel)	
5	A pre-transfer safety meeting has been held and the transfer plan has been agreed (Discussions should include method of communications, use of standard crane signals, etc)	
6	Site conditions, including sea state, currents, wind speed and direction and weather, have been assessed to ensure that the transfer can be conducted safely (If the transfer is to take place at night, check availability of search lights and flood lights)	
7	The deck area is clear of obstruction to safely land the basket	
8	A simulated transfer has been undertaken prior to first transfer of personnel	
9	Radio contact has been established between the two vessels and the responsible person in charge of the transfer arrangements on deck	
10	Where possible, raising and lowering of the basket will be mainly carried out above the sea and not above the vessel	
11	The reach of the lifting equipment extends sufficiently far enough to ensure that the basket will not be pulled over excessively during the transfer	
12	A lifebuoy with light and line is available at the transfer location	

D. Personnel being Transferred

	Personnel understand the transfer procedure and transfer sequence and have been instructed to hold on at all times and observe all instructions from those in charge of the operation	
2	Personnel have agreed to be transferred	
	The correct PPE is being worn (Minimum PPE requirements are a PFD and a safety helmet)	

Name:

Rank:

Signature:

Date:

Other considerations:

1. Both vessels have clear authority to stop the transfer if conditions are considered unsafe.
2. Individuals being transferred should wear a PFD and a safety helmet. All PFDs should be equipped with suitable means of illumination during night time transfers.
3. A rescue boat should be available for immediate launching in the event that a person falls into the sea during the transfer.
4. The limitations associated with the minimum or maximum angles of crane booms should be considered. It is recommended that the minimum outboard reach should be five metres at the lowest jib angle.

Appendix G: Example checklist for transfers involving vapour balancing

SHIP TO SHIP TRANSFER

CHECKLIST FOR TRANSFERS INVOLVING VAPOUR BALANCING

Discharging Ship's Name:

Receiving Ship's Name:

Name of Designated POAC:

Name of STS Superintendent if Different from POAC:

Date and Place of Transfer:

		Discharging Ship Checked	Receiving Ship Checked	Remarks
1	State pressure in cargo tanks (mm, WG or psi)			
2	Tank oxygen content is below 8% by volume			
3	Tank high-level alarms and overfill alarms have been tested within the last 24-hours			
4	Vapour recovery/balancing valves are correctly positioned			
5	The vapour recovery hose is inerted			
6	Deck seal and P/V breaker levels have been checked and are satisfactory			
7	Leak testing will be performed by:			[State method]
8	Vessel pressure and vacuum relief settings in: Liquid p/v breaker Tank p/v valves Mast head p/v valve(s) Other p/v relieving devices			[Specify]
9	Type of vapours from present/previous cargoes			
10	Initial cargo transfer rate (m^3/hr or bbls/hr)			
11	Maximum cargo transfer rate (m^3/hr or bbls/hr)			
12	Maximum acceptable pressure differential at maximum transfer rate (mm, WG or psi)			
13	Cargo tank pressure range to be maintained (mm, WG or psi)			

14	Cargo tank pressure alarm set points: High alarm (mm, WG or psi) Low alarm (mm, WG or psi)			
15	IG main pressure alarm set points: High alarm (mm, WG or psi) Low alarm (mm, WG or psi)			
16	Vapour emission control system pressure alarm set points: High alarm (mm, WG or psi) Low alarm (mm, WG or psi)			
17	Oxygen analyser has been checked and calibrated State alarm set point (% volume)			
18	Agreement on the following sequences and procedures: Normal start up: Normal shutdown: Low vapour pressure alarm: High vapour pressure alarm:			

FOR DISCHARGING / RECEIVING SHIP (Delete as appropriate)

Name:

Rank:

Signature:	Date:

Appendix H: Fender selection calculation

The following is only a guide and it is recommended that individual fender manufacturers, fender rental companies or STS service providers are consulted when planning an STS operation.

To calculate a suitable fender arrangement it is necessary to calculate the berthing energy of a ship that must be absorbed by the fender at the point of contact.

The surrounding seawater acts to push the ships towards one another upon berthing. Therefore, when calculating the berthing energy, a constant 1.8 is used to adjust for this extra force.

To determine the berthing energy when landing on one fender, quarter point berthing is assumed.

Step 1: Ship A Displacement × 1.8 = Ship A Adjusted Displacement

Ship B Displacement × 1.8 = Ship B Adjusted Displacement

Step 2:

$$\frac{\text{Ship A Adjusted Displacement} \times \text{Ship B Adjusted Displacement}}{\text{Ship A Adjusted Displacement} + \text{Ship B Adjusted Displacement}} = \text{Total Adjusted Displacement}$$

Step 3: Berthing Energy (in tonne.m) = 0.025 × Total Adjusted Displacement × Approach Velocity (in m/sec) squared.

Example:

Ship A: 65,000 Displacement, Ship B: 312,000 Displacement, Approach Velocity 0.2 m/sec, one fender landing.

Step 1: 65,000 × 1.8 = 117,000

312,000 × 1.8 = 561,600

Step 2:

$$\frac{117{,}000 \times 561{,}600}{117{,}000 + 561{,}600} = 96{,}827$$

Step 3: $0.025 \times 96{,}827 \times 0.2^2$ = **96.8 tonne/m Berthing Energy**

Now refer to the fender manufacturer's performance tables and select a fender system that will provide energy absorption capability in excess of that indicated by the calculation above. Indicative tables for pneumatic and foam fenders are shown on the next page, but could differ between various manufacturers.

Table H1: Typical performance data for pneumatic and foam fenders

[1] *For fenders complying with ISO17357:2002 (reference 23)*

[2] *Energy absorption of foam fender depends on berthing angle and repetitive compression factor. Confirmation from fender manufacturers should be obtained.*

Low Pressure Fenders

Nominal Size		Typical EA @ 60%	Nominal Size		Typical EA @ 60%	Nominal Size		Typical EA @ 60%
Dia.	Length		Dia.	Length		Dia.	Length	
m	m	tonne.m	m	m	tonne.m	m	m	tonne.m
1.8	**6.0**	17.2	**2.8**	**10.0**	68.9	**4.5**	**16.0**	311.4
1.8	**8.0**	26.6	**2.8**	**14.0**	107.1	**4.5**	**18.0**	367.6
1.8	**10.0**	35.6	**2.8**	**18.0**	144.9	**4.5**	**20.0**	413.3
1.8	**12.0**	44.8	**2.8**	**22.0**	183.7	**4.5**	**22.0**	465.7
2.3	**8.0**	38.8	**3.3**	**12.0**	113.3	**4.5**	**30.0**	694.4
2.3	**10.0**	52.0	**3.3**	**16.0**	165.4			
2.3	**12.0**	66.3	**3.3**	**20.0**	216.4			
2.3	**16.0**	93.9	**3.3**	**24.0**	267.4			

Table H2: Typical performance data for low pressure fenders

Approach velocity

The approach velocity of the ships can have a dramatic effect on the berthing energy absorption requirements of the fender system. The allowance for velocity should take into consideration the effects of local weather, sea and swell conditions, tug or thruster availability and the physical size of the ships involved. It is common to work within a range of about 0.1 to 0.3 metres per second (0.2 to 0.6 knots) and it should be noted that an increase of about 0.02 (m/sec) (0.04 kts) in velocity could result in approximately 28% increase in energy absorption requirements should the berthing speed be in the range of 0.15 m/sec, and 20% increase should the berthing speed be in the range of 0.20 m/sec. Also note that smaller ships tend to have higher berthing velocities.

During berthing operations between two ships it is rare that they make parallel contact with each other and it is more likely that one fender will absorb the initial contact. Under this condition some of the energy is absorbed by the action of the ship pivoting around the fender and it is generally accepted that about half of the energy is absorbed in this manner. To determine the berthing energy for a parallel berth, the following formula is worked:

Berthing Energy (in tonne.m) = 0.051 x Total Adjusted Displacement x Approach Velocity (in m/sec) squared.

In the event of parallel contact the load will be spread over the remaining fenders in the system.

Pneumatic fender energy absorption characteristics

Table H1 provides information on energy absorption values for fenders based on typical data from manufacturers. These values assume a maximum guaranteed energy absorption at 60% compression. While this value should be used for assessing fender requirements, it should be borne in mind that most manufacturers of pneumatic fenders ensure that a safety margin is built in to the design to protect against accidental over-deflection beyond the guaranteed value. This is illustrated in the following graphic:

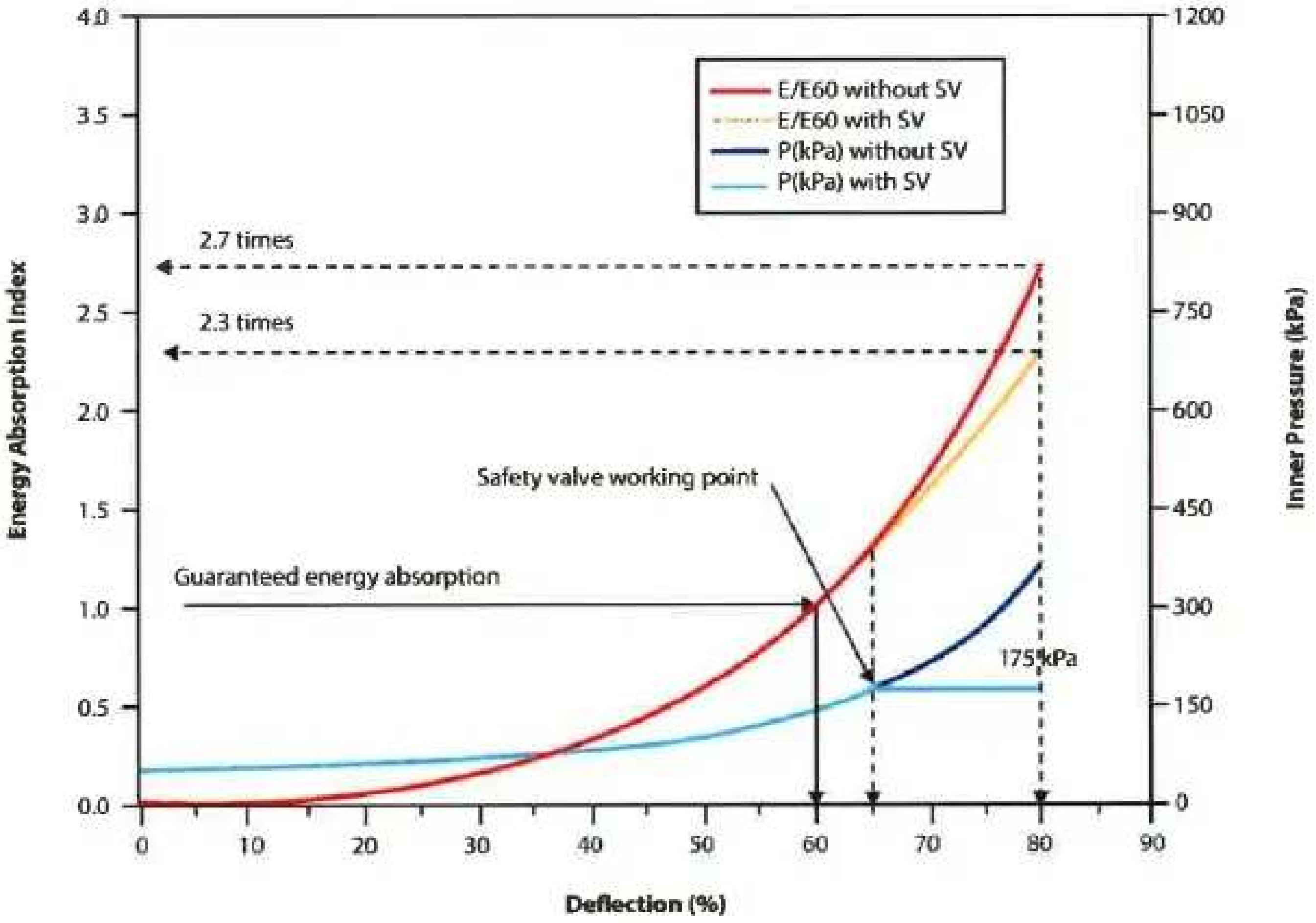


Figure H1: High pressure fender energy absorption characteristics

In the diagram, the guaranteed energy absorption is shown at 60% deflection, equating to an energy absorption index of 1.0. The safety valve is shown to typically lift at a pressure equivalent to approximately 65% deflection, equating to an energy absorption index of 1.3. If subjected to continuing forces, the fender will continue to absorb the energy until the deflection reaches the largest diameter of the mouthpiece metal parts. At this stage, the fender will be subjected to an over-compression equivalent to some 2.3 times the fender's designed energy absorption capability.

To obtain an understanding of the safety margins associated with fenders, it is recommended that operators consult with manufacturers to determine the design energy absorption capabilities and compressibility limitations of their products.

Fender Selection Assistance Request Form For ship to ship use To be filled out prior to contacting fender providers		
Location of Site		
Potential sea state ____________	Potential Beaufort Scale ____________	
	Ship A	**Ship B**
Type of ship e.g. tanker, gas carrier		
Displacement tonnage at start of STS operations		
Length overall		
Length between perpendiculars		
Parallel body length at start of STS operation [Forward and aft of centreline]	F____A____	F____A____
Parallel body length at completion of operation [Forward and aft of centreline]	F____A____	F____A____
Freeboard at start of operation		
Freeboard at completion of operation		
Relative approach velocity of ships		
Other relevant information		

Appendix I: Considerations applicable to reverse lightering operations

Reverse lightering, sometimes referred to as topping-off, is a ship to ship (STS) transfer operation in which a laden tanker, typically of Suezmax or Aframax size, is manoeuvred alongside a partially laden very large crude carrier (VLCC) or ultra large crude carrier (ULCC) in order to transfer cargo to the larger vessel. This differentiates the operation from conventional STS activities in which the manoeuvring vessel is typically in a ballast condition.

In reverse lightering operations, the manoeuvring vessel is often fully laden and will therefore be more difficult to manoeuvre alongside in anything other than calm weather conditions. Primary fenders will commonly be rigged on the manoeuvring ship and, in planning the operation, it is prudent to err on the safe side when selecting fenders and to take account of the potential for increased berthing velocities and higher angles of approach when compared with conventional STS operations. Should fenders of a larger size than required through calculation be available, consideration should be given to their employment.

If the size of available fenders poses limits on acceptable berthing velocities, arrangements should be made to ensure that these berthing velocities are not exceeded. These would include, for example, imposing environmental limits on the operation or requiring the use of tugs to assist in berthing.

The following additional considerations relate to reverse lightering:

- Before committing to a reverse lightering operation, the parties involved should carry out a risk assessment as outlined in section 3.2 of this Guide.
- When considering a reverse lightering operation, berthing energy should be calculated using the formulae in appendix H in order to determine the required fender absorption capability.
- Consideration may be given to using STS berthing simulation tools to calculate berthing forces and stand-off distances in varying environmental conditions to assist in the identification of weather windows for an operation.
- Due account should be taken of the effect of approach velocities on the berthing energy absorption characteristics of the fender system. Weather, sea and swell conditions will influence the ability of the loaded vessel to manoeuvre during the berthing approach and should be considered as a limiting factor.
- When planning a reverse lightering operation, due consideration needs to be given to the availability of fenders of a required type and size and of equipment, such as service vessels, capable of safely handling them.

Appendix J: Guidance for connection of individual hose lengths to assemble a hose string

It is not uncommon for hoses to be delivered in individual lengths to one of the vessels scheduled to perform an STS transfer operation. In such situations it will be necessary for the ship's personnel to connect the individual hose lengths together in order to assemble one or more hose strings with sufficient length to deploy between the vessels performing the STS transfer operation.

It should be ensured that the hose connection flanges that are deployed outside the containment areas of both vessels have been connected in a manner that will ensure their liquid containment integrity for the duration of the cargo transfer operation.

Ship's personnel should be provided with the means to connect the hose lengths together effectively, using:

- Suitable new gaskets.
- Nuts and bolts.
- Torque wrench.
- Gasket manufacturer's instructions regarding the optimum final torque compression setting for the supplied gaskets.

The following notes are intended to provide general guidance to ensure the liquid containment integrity of hose connection flanges when the hose strings are assembled.

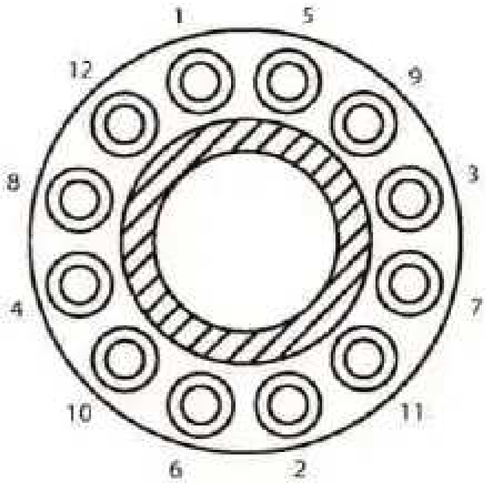


Figure J1: Flange diagram

Preparation

Prior to connection of the two hoses, the flange faces should be inspected and cleaned to ensure all residues and debris from previous gaskets or fixatives are removed completely. For best results, use a metal flange scraper, an aerosol gasket remover and a wire brush, then inspect the flange for damage. Be sure surface finish and flatness are satisfactory.

Lubricate bolt and nut threads and nut bearing face (where it contacts the flange).

Centre the gasket on the flange. Note: standard American National Standards Institute (ANSI) ring gaskets, when cut properly, should centre themselves with the bolts in place.

Do not re-fit old gaskets.

Typical tightening process

After the flange has been assembled and all nuts have been run down by hand with the joint in place, wrench tightening should follow the sequence of the numbers indicated on the flange diagram in figure J1. Marking the number on the flange with a wax crayon aids in keeping track of the tightening process.

During the following steps, any gap between the flanges should be kept even all around the circumference, and nuts should be made up approximately the same amount on each end of the bolt.

1) First time around, the nuts should be just snugged with a hand wrench.
2) Second time around, the nuts should be tightened firmly with the same wrench.

A torque wrench should then be used for the following steps:

3) Third time around, apply approximately 25% recommended torque.
4) Fourth time around, apply approximately 75% of recommended torque.
5) Fifth time around, apply 100% of recommended torque.
6) Continue tightening nuts all around until they do not move under 100% recommended torque.

Nuts should be re-torqued periodically. It should be noted that most of the short-term bolt preload loss occurs within 24-hours after initial tightening.

Appendix K: Guidance on risk assessment processes

The following guidance is provided to assist with the preparation of a risk assessment addressing ship to ship (STS) operations. The information is not exhaustive and is intended to indicate the nature and scope of issues that should be considered during the process.

K.1 Examples of high level risks

High Level Risk	Description
Low energy collision	Inadequate control during berthing/unberthing and side-by-side operations leads to hull to hull contact/collision leading to physical damage to one or both ships
Mooring operations	Inadequate control during mooring, unmooring and side-by-side operations leads to personal injury or fatality
High energy collision	Inadequate navigational control by ships involved in STS transfer operation or a third party passing vessel causes a high energy collision during mooring, unmooring or transfer operations resulting in significant equipment damage, fatalities and loss of containment
Loss of containment	Hardware failure, overflow or overpressure due to inadequate control during transfer leads to a loss of containment and cargo release
Loss of containment - vapour	Inadequate control during transfer leads to an uncontrolled event that results in a loss of containment and vapour release leading to ignition back to source resulting in fatalities/injury/hardware/steelwork damage
Loss of containment - vapour in confined space	Inadequate control during transfer leads to an uncontrolled event that results in a loss of containment leading to vapour collection in a confined space, leading to ignition with explosion, causing fatalities/injury and hull damage
Personnel transfer	Failure or improper use of equipment used in personnel transfer leads to a loss of control during transfer resulting in fatality or injury
Damage to cargo tanks	Cargo sloshing due to ship motions in the prevailing swell conditions results in damage to cargo tank structure resulting in the ship being unfit to trade
Personal injury during hose handling	Equipment failure or failure to follow procedures leads to injury or fatality and damage to assets
Mooring breakaway	Failure to maintain mooring integrity, deteriorating weather and/or poor manoeuvring results in mooring failure. Consequences include loss of containment, damage to cargo equipment and risk of personal injury

K.2 Examples of causal factors

The following are examples of causal factors that could contribute to high level risks. They describe events or activities that may contribute to triggering a particular risk. Knowledge of causal factors will assist with the development of barriers and preventive measures aimed at minimising the occurrence of the associated risk.

- Steering/propulsion failure.
- Fender defect.
- Inadequate fendering.
- Mismatched manoeuvring characteristics.
- Pilotage error.
- Insufficient manoeuvring room.
- Inadequate watchkeeping.
- Inadequate communication.
- Inadequate training.
- Inadequate procedures.
- Inadequate experience.
- Fatigue.
- Failure to follow procedures.
- Abnormal metocean conditions.
- Poor visibility.
- Inadequate site selection.
- Inadequate weather forecasting.
- Inadequate tug/support vessel.
- Inadequate operational planning and control.
- Inadequate planning for emergency breakaway.
- Inadequate information on vessel motion limits for all filling levels.
- Large roll angles.
- Different roll periods.
- Tug/support vessel failure.
- Passing ship effect.
- Inadequate compatibility study - bridge wing separation and parallel body lengths.
- Inadequate equipment inspection, testing and maintenance.
- Equipment not fit for purpose.
- Equipment unapproved/not fit for purpose.
- Mooring equipment failure.
- Damaged moorings due to chafing and cyclic loading.
- Inadequate compatibility study - personnel landing area.
- Defective personnel transfer equipment.
- Inadequate transfer equipment (type approval/ fit for purpose).
- Level measurement and overfill protection systems inadequate for open water operation.
- Transfer rate too high.
- Defective overfill protection.
- Inadequate contingency planning.
- Inadequate incident management.

K.3 Examples of risk mitigation measures

STS Superintendent - ship handling skills and local knowledge	Experienced STS Superintendent available on manoeuvring ship and responsible for operational liaison and assisting with mooring/ unmooring manoeuvres
Knowledge of ship handling characteristics	Ship handling characteristics reflected in manoeuvring plan
Bridge team experience and competency	High standard of bridge team management established through experience and specific STS training
Operating procedures	Clear and detailed operating procedures established for all phases of the STS operation, including ramp up/down procedures and maximum loading rates. Procedures define communication requirements, responsible parties and accountabilities for each phase of the operation. For open water STS transfer the operating procedures will address visibility, the monitoring of third party traffic and detail the actions to be taken if third party traffic is predicted to enter closest point of approach (CPA) limits. Crews are trained and familiar with operating procedures
Contingency planning	Detailed contingency plans are established for STS specific emergencies. Plans address control, responsibility and actions required on both ships. Crews trained and drilled in emergency procedures
STS equipment fit for purpose	All equipment used in the STS is fit for purpose and meets appropriate international standards and conforms to accepted industry guidelines
Pre and post-operational checks	Detailed checklists, as per accepted industry guidance, completed for all phases of the transfer operation
Life cycle equipment replacement policy	Life cycle equipment replacement policy established on the basis of operational experience and manufacturer's recommendations
Overfill alarms/filling valve shutdown	Overfill and tank protection alarms and shutdown systems are fully operational at all times and maximum fill levels are adjusted to ensure that these systems operate effectively in open water where appropriate
Personnel resource and capability	Adequate competent and experienced personnel are available on both ships to ensure effective operational control and acceptable hours of work
STS environmental operating limits	Clear operating limits defined in the operating procedures for all stages of the operation. The operating limits consider: i) Restrictions due to poor visibility/night time operations ii) manoeuvring capability iii) the operating limits of mooring and fendering systems iv) where applicable, motion studies to define maximum environmental conditions for an acceptable sloshing risk when cargo transfer operations are undertaken in open water

Appendix L: Example liquefied natural gas ship to ship transfer compatibility questionnaire

Ship's Name:

Date:

Documents to be forwarded with this questionnaire

General arrangement plan

Mooring arrangements

Vessel particulars questionnaire (VPQ)

Ship's Name:

Ship Contact Details

Tel:
Fax:
Tlx:
Mobile:
E-mail:
MMSI

Owner Contact Details

Name:
Address:
Tel:
Fax:
Tlx:
E-mail:

Technical Managers

Name:
Address:
Tel:
Fax:
Tlx:
E-mail:

Commercial Managers

Name:
Address:
Tel:
Fax:
Tlx:
E-mail:

Charterer

Name:
Address:
Tel:
Fax:
Tlx:
E-mail:

Ship's Name:

General

Call Sign:
IMO Number:
Flag:
Port of Registry:
Date Delivery:
Class Society:
Class Notation:

Dimensions

Length Overall (LOA):
Length BP:
Breadth Moulded:
Depth Moulded:
Keel to Masthead:

Tonnages

Gross Tonnage:
Nett Tonnage:

Loadline

Summer Deadweight:
Displacement:
Normal Loaded Draught:
Normal Loaded Freeboard:
Normal Ballast Draught:
Normal Ballast Freeboard:

Propulsion

Type of Engine:
MCR: HP at RPM
NCR: HP at RPM
Type of Propeller:
Bowthruster number:
power/unit HP
Sternthruster number:
power/unit HP

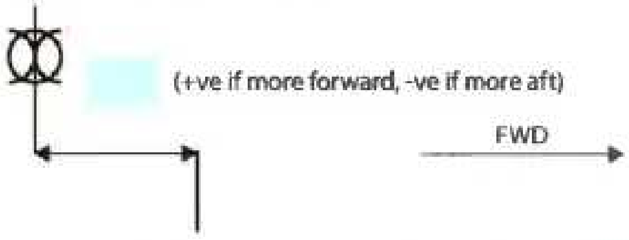
Crew

Common language onboard
Are officers and manifold watchmen proficient in English?

Are officers and manifold watchmen proficient in English?

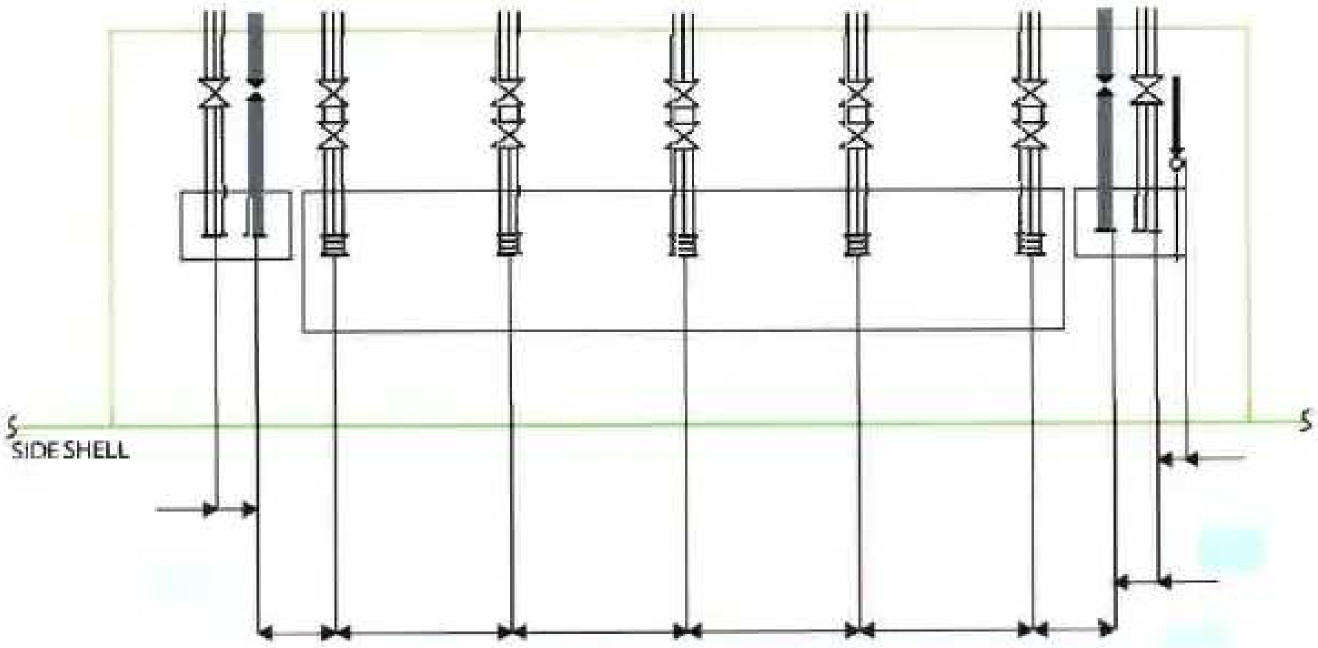
Ship's Name:

Indicate distances in mm


(+ve if more forward, -ve if more aft)

State Liq or Vap Size

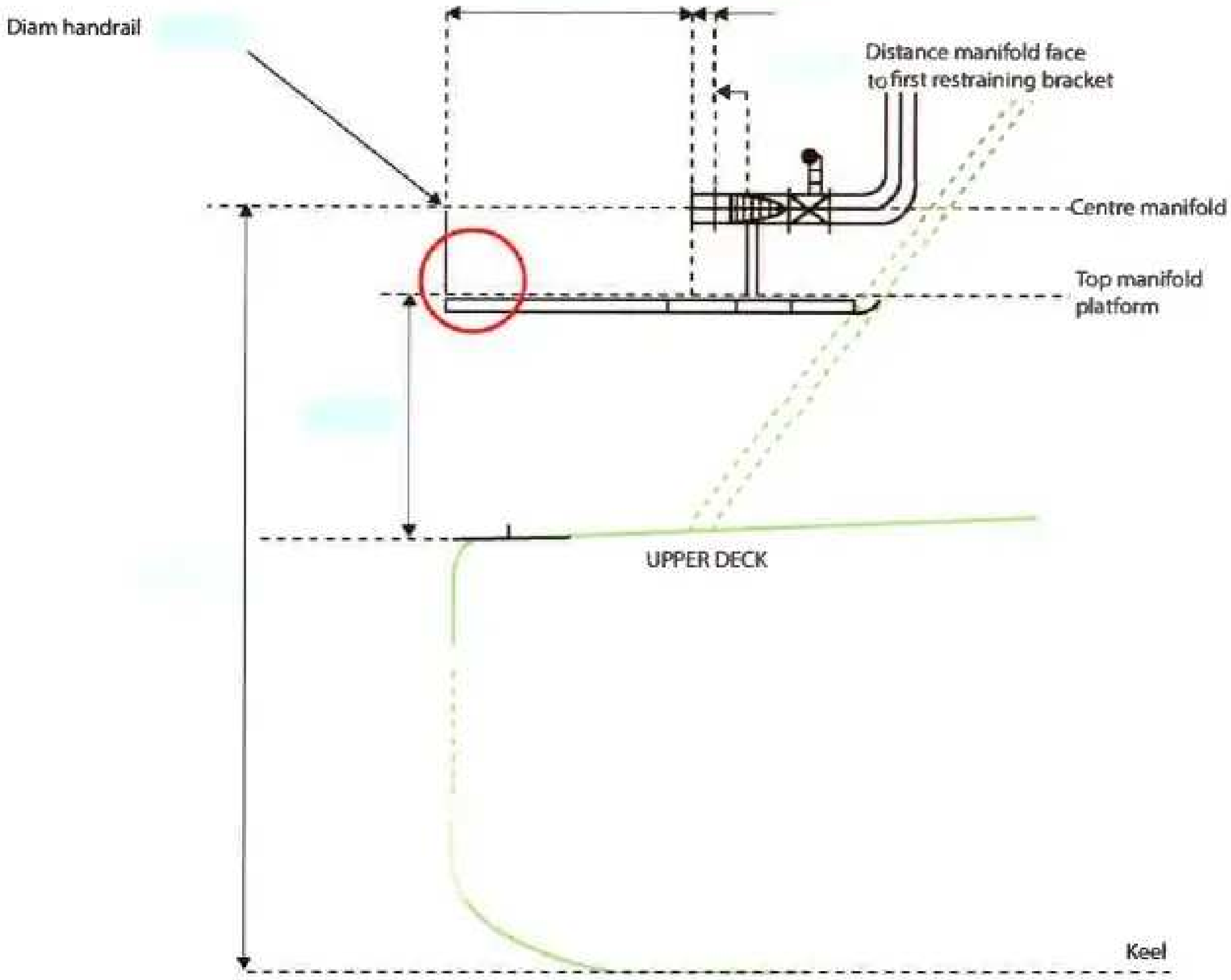
Flange ANSI
Face size (inches)
Thickness (mm)
Flange Face



Type of manifold valves:
Number and types of reducers:

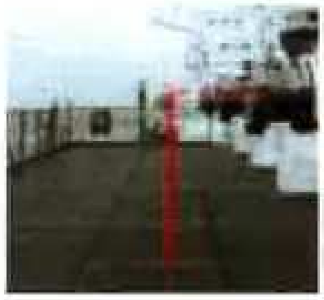
Short distance piece installed:

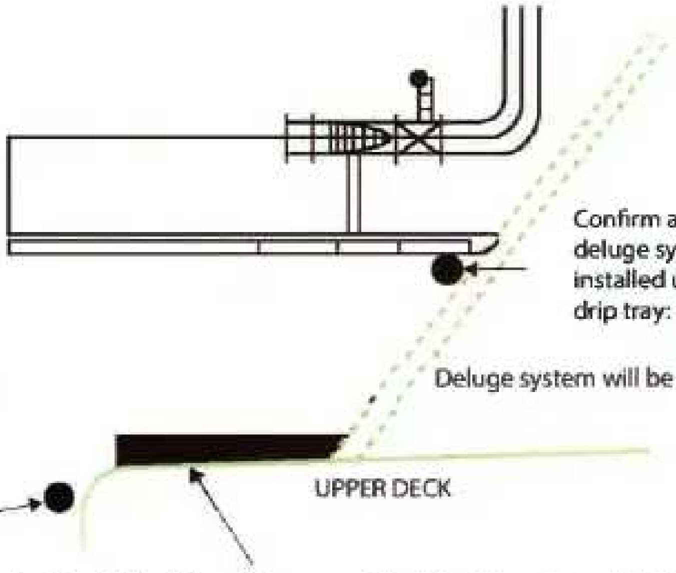
Length =



Height centre of manifold measured till grating of manifold platform

mm





Confirm a water deluge system is installed under drip tray:

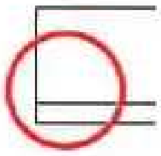
Deluge system will be supplied

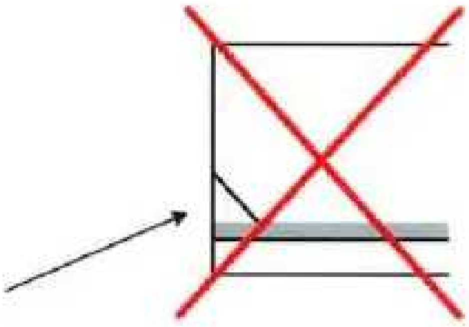
Confirm a water deluge system is installed to protect ship's hull

Confirm YOU will install a means of holding the water under the drip tray, by using wooden planks and cement:

No obstructions (railing supports or others) between railing stanchions and manifold platform:

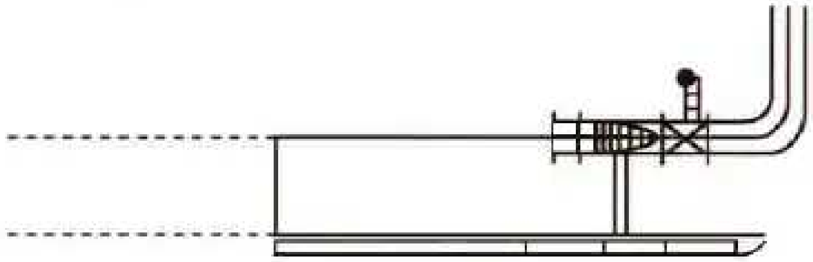
Are obstructions removable?





No inclination between ship's manifold and manifold platform:

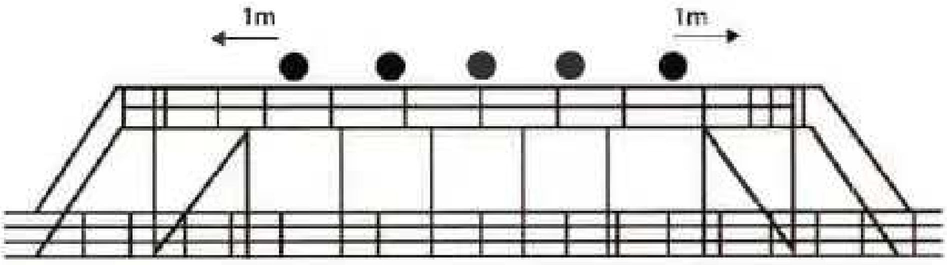
State degree of inclination:



Confirm strainer is not obstructing any (bypass) valve or others:

No obstructions over full handrail from 1 m outwards (as per drawing)?

Indicate Possible Obstructions on Drawing Below

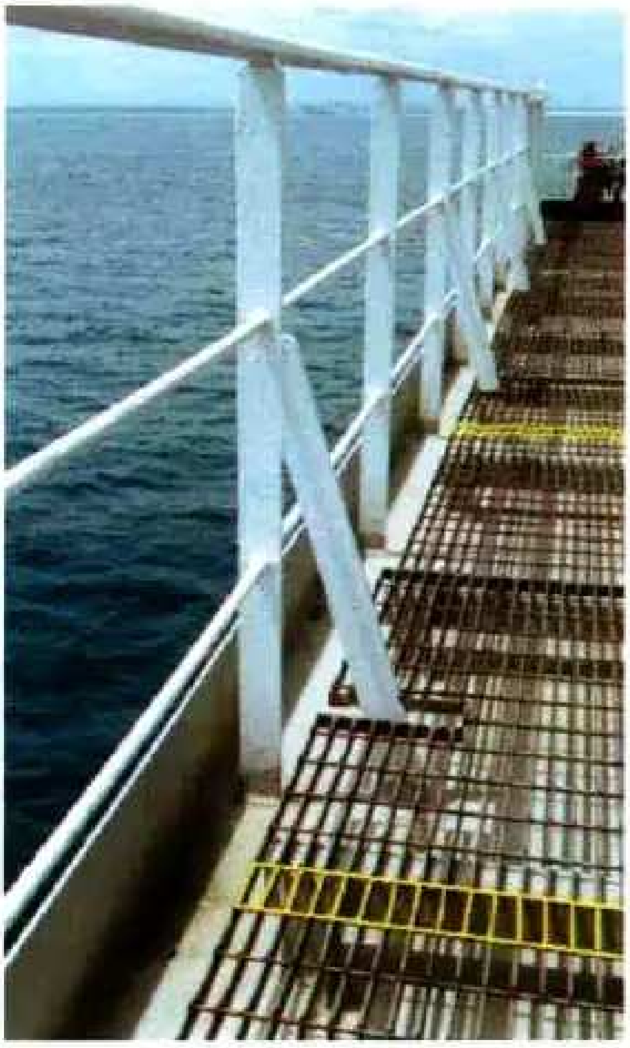


Height of railing measured to grating of manifold platform: mm

confirm gutter plate installed

height: mm

Insert a picture as per example below for port and starboard side:



Confirm the centre lines of the manifolds will be marked as shown on the grating.

Cargo containment system:

		1	2	3	4	5
Capacity 98.5%	per tank:	m^3	m^3	m^3	m^3	m^3
	total:	m^3				
Sloshing limits:	Lower:					
	Higher:					

State the maximum time needed to re-arrange the cargo tanks to be out of the sloshing limits, at any moment during discharging at a rate of 5,400 m^3/hr hrs

Maximum cargo tank working pressure: kPa
Tank pressure relief valve settings: kPa

Cargo pumps	capacity	m^3/hr	Spray pumps	capacity	m^3/hr
	number			number	
	head	m		head	m

Maximum pressure at manifold

Gas to shore counter fitted type:
Gas from shore counter fitted type:
Gas to engine counter fitted type:

Boil off gas (BOG) burning capacity t/h

Reliquefaction fitted
if yes, capacity

N_2 plant	Capacity	N m^3/hr
	Working Pressure	MPa
	Max O_2 content	%Vol

Type of connection

Hose Handling Cranes

number		
SWL		t
maximum outreach of the ship's side		m
approved for personnel transfer?		

LBP		m	normally length of the ship's waterline when loaded
Breadth		m	
Depth		m	measured from keel to main deck
Target (vessel's manifold)		m	forward from midships (negative if aft of midships)
		m	above deck level
End-on projected windage area		m^2	above main deck
Side projected windage area		m^2	above main deck
Current drag data based on			Conventional or cylindrical bow
Wind drag data based on			Prismatic or spherical
Wave motion data based on			Prismatic or user-defined
Distance main deck – keel		m	

Mooring Lines on Winches

Starboard Side

No.	Fairlead distances				Winch brake	Line				Tail Rope		
	From AP to fairlead	centreline to fairlead	Ht above main deck	fairlead to winch		Size	Type	BL	Length	Size	Type	BL
	m	m	m	m	tonne	mm		tonne	m	mm		tonne
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

Mooring Bitts and Enclosed Fairleads

No.	SWL	from AP to fairlead	centreline to fairlead	Ht above main deck	distance to bollard	bollard SWL	<35m from centre	capstan	
	tonne	m	m	m	m	tonne	y/n	y/n	capacity

1									
2									
3									
4									
5									
6									
7									
8									

LBP		m	normally length of the ship's waterline when loaded
Breadth		m	
Depth		m	measured from keel to main deck
Target (vessel's manifold)		m	forward from midships (negative if aft of midships)
		m	above deck level
End-on projected windage area		m²	above main deck
Side projected windage area		m²	above main deck
Current drag data based on			Conventional or cylindrical bow
Wind drag data based on			Prismatic or spherical
Wave motion data based on			Prismatic or user-defined
Distance main deck – keel		m	

Mooring Lines on Winches

Port Side

No.	Fairlead distances				Winch brake	Line				Tail Rope		
	From AP to fairlead	centreline to fairlead	Ht above main deck	fairlead to winch		Size	Type	BL	Length	Size	Type	BL
	m	m	m	m	tonne	mm		tonne	m	mm		tonne
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

Mooring Bitts and Enclosed Fairleads

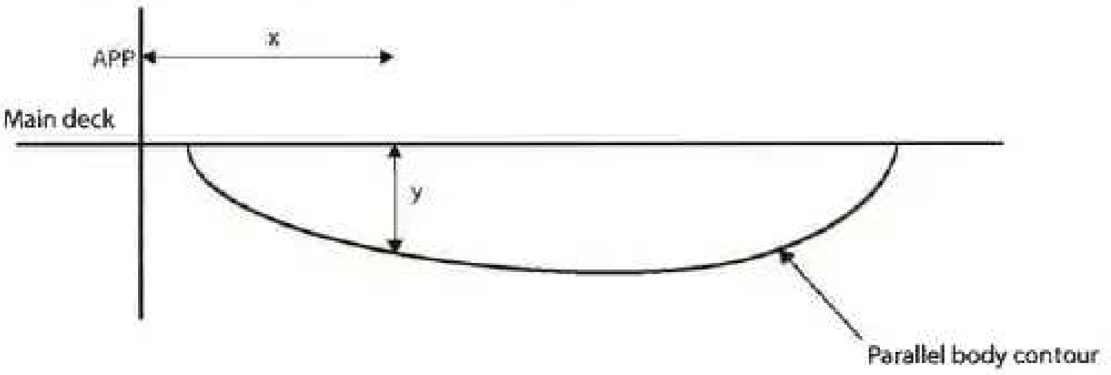
No.	SWL	from AP to fairlead	centreline to fairlead	Ht above main deck	distance to bollard	bollard SWL	<35m from centre	capstan	
	tonne	m	m	m	m	tonne	y/n	y/n	capacity

1									
2									
3									
4									
5									
6									
7									
8									

Is vessel fitted with 2x2 soft spring ropes between spring wire and rope tail, connected by Mandal or Tonsberg shackles?

LBP m

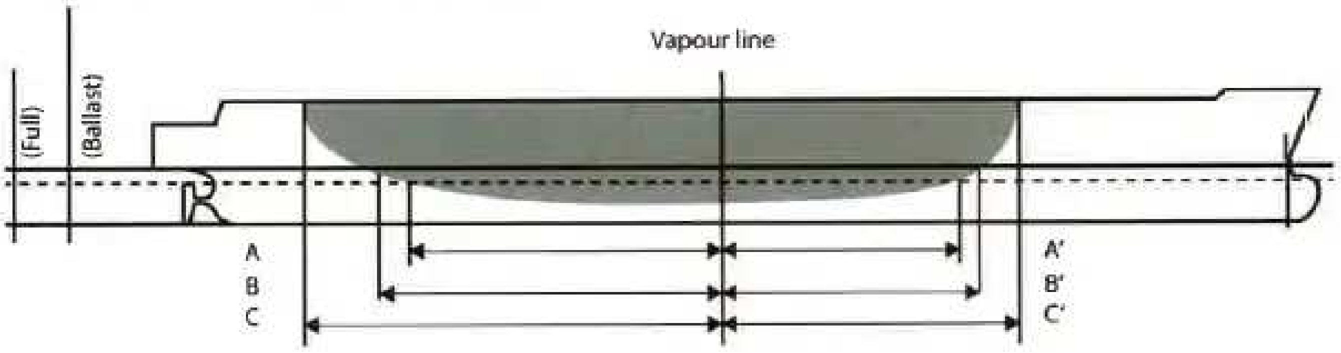
Parallel body contour for ballast condition



Indicate below vertical distances from main deck to parallel body contour in ballast condition for different distances (1 to 12) to APP

Parallel Body Counter	1	2	3	4	5	6	7	8	9	10	11	12
Distance in m from APP X												
Depth in m from main deck Y												

Parallel body length for different conditions

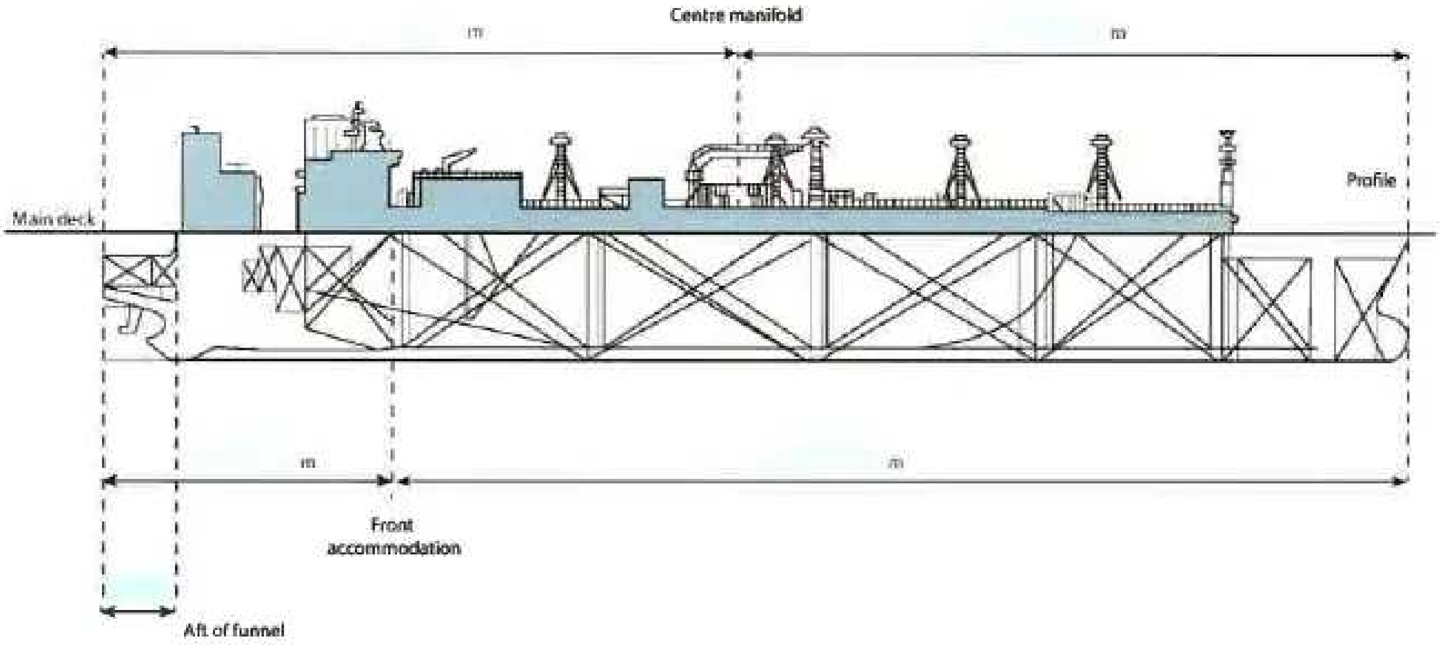


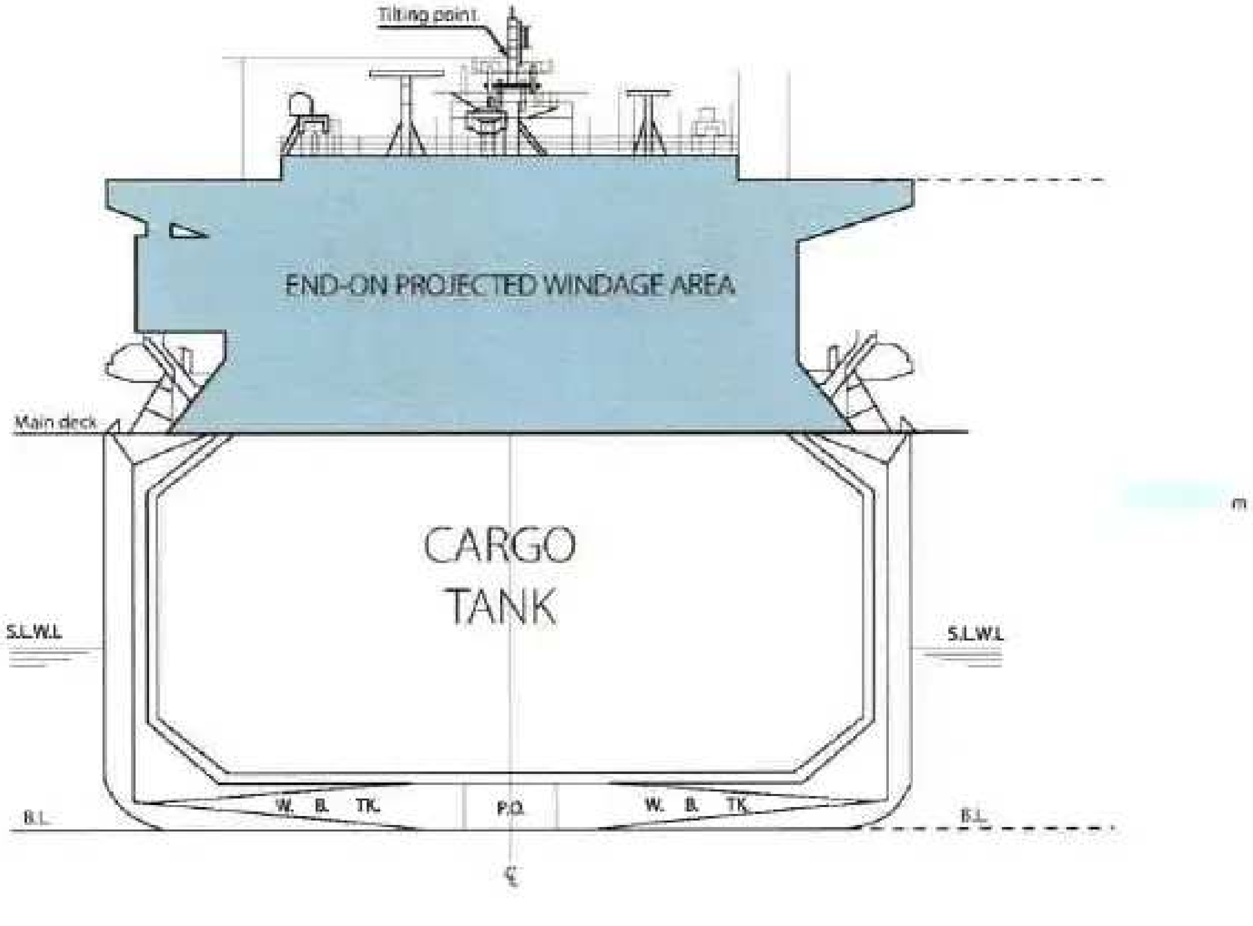
Full: A= m A'= m

Ballast: B= m B'= m

Main deck: C= m C'= m

Hull Pressure Limit t/m^2


Centre manifold
m
m
Profile
Main deck
m
m
Front accommodation
Aft of funnel


Tilting point
END-ON PROJECTED WINDAGE AREA
Main deck
m
CARGO TANK
S.L.W.L
S.L.W.L
W. B. TK.
P.O.
W. B. TK.
B.L.
B.L.
℄

Emergency shutdown (ESD) links

Optical fibre:
Connector type:
Connection point position to centre manifold: m

Pneumatic:
Connector type:
Connection point position to centre manifold: m
Setting pressure in MPa:

Electrical:
Connector type:
Connection point position to centre manifold: m
Include plug pin arrangement

Are ESD cables and/or hoses available?
ESD valves closure time sec